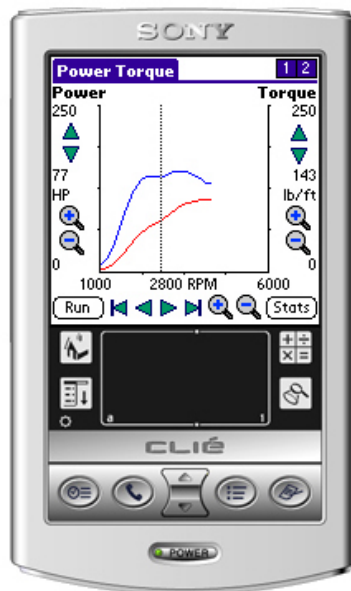




PDA-Dyno™ and OBD II Scan Tool

Operating Manual



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Patent Pending

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Chapter 1 : Preface

Congratulations on your PDA-Dyno™ purchase. Please read the operating instructions and become familiar with the operating procedure.

The PDA-Dyno™ and Palm handheld computer, enables access to your vehicle's diagnostic information. Read and clear Diagnostic Trouble Codes from the vehicle's memory, turn off the "Check Engine" light, and read real-time sensor measurements are just some of the features offered by the OBD II Scan Tool. The Dyno features add a performance-measuring package that includes a dynamometer, acceleration tests, and fuel economy measurements.

If you are planning to use the PDA-Dyno on vehicles with CAN OBD- II you must use the correct PDA-Dyno interface. Order accordingly.

The Nology PDA-Dyno and Scan Tool 440 001 111, 440 001 112 and 440 001 113 works on CAN, VPW, PWM, ISO, EU-OBD II and KWP2000 communication protocols.

Features

1. Dynamometer – measure horsepower and torque from any vehicle. Obtain statistics like maximum horsepower and torque. Dyno setup takes into account all variables such as vehicle weight, air temperature, and elevation. SAE J1349 corrected HP and torque figures ensure results can be correlated from any elevation and weather conditions.
2. Acceleration – measure 0-60 time, 1/8 mile time and speed, 1/4 mile time and speed, and 1/4 mile horsepower. Acceleration curves show the vehicles acceleration profile.
3. Fuel Economy – an instantaneous and trip MPG display shows the vehicle gas mileage while driving¹.
4. Gear ratio – gear ratio measurement and tire diameter calculator.
5. Data logging and playback. Record sensors while driving and playback later.
6. Read and clear diagnostic trouble codes (DTCs)
7. Turn off the vehicle's Check Engine or Service Engine Soon light
8. Read and clear freeze frame data
9. Monitor live data with line graphs, bar graphs, and meters
10. Graphically zoom in/out and pan
11. View multiple sensors simultaneously with variable sample rates
12. Record and playback live sensor data streams
13. Upload recordings to a PC for further analysis
14. Oxygen sensor monitoring and on-board test results

¹ Only available of vehicles equipped with mass air flow sensors.

15. Improved graphing support. Zoom and scrolling on both the x and y-axis allows unparalleled ease in viewing of data.
16. Graph screen with two traces on a single graph control. Especially useful for color screens.
17. Graph Marker on all graph screens allows finding the precise data value on any point within the graph.
18. Graph trace buffer saves numerous pages worth of graphed data. Scroll right and left to view the data stored within the trace buffer.
19. Increased data sampling speed.
20. DTC Lookup – users can lookup textual descriptions for trouble codes right on the PDA. Hundreds of SAE definitions are built right into the software.
21. Dual Graphing – two sensors can be graphed simultaneously; horizontal and vertical zoom and a side scrolling graphical display is more functional.
22. List Screen – list screen displays up to five sensors simultaneously.
23. Auto-Off Timer – a preference option temporarily disables the Palm automatic power-off.
24. Pause – pause available on Meter, List, and Graph screens.
25. I/M readiness. Metric and English units of measure
26. Supports most Palm OS devices version 3.0 and later.
27. Color and black-and-white screens supported
28. Always Free software upgrades via our web site
29. Free tech support forever
30. Limited Lifetime Warranty

What is OBD II?

On-Board Diagnostics Second Generation (OBD II) is required for all 1996-and-later vehicles. It is intended to reduce in-use vehicle emissions by continually monitoring all emission control systems and sensors. A Malfunction Indicator Light (MIL) (i.e. Check Engine light or Service Engine Soon light) must be illuminated and a Diagnostic Trouble Code (DTC) set when there is a failure of a monitored component such that the vehicle's emissions would exceed the relevant standard by approximately 50 percent.

The PDA-Dyno™ uses the OBD II connector under the dash to communicate with the vehicle's on-board computer systems.

What is a Scan Tool?

The automobile computer relies upon a variety of sensors to monitor vehicle operation such as speed, engine RPM, coolant temperature, and oxygen sensors. While driving, if the vehicle's on-board computer system detects a problem the computer reports the error using a Diagnostic Trouble Code (DTC). A DTC number indicates the problem with the vehicle. For instance, DTC P0503 means the

vehicle speed sensor is intermittently not providing the correct reading. All generic Diagnostic Trouble Codes are listed in Appendix A: Diagnostic Trouble Codes (SAE J2012).

The scan tool connects to the vehicle OBD II connector. Once connected, the scan tool communicates with the vehicle's computer to obtain diagnostic information, such as a Diagnostic Trouble Code.

If the vehicle computer detects a problem, the driver is informed using the "Check Engine" or "Service Engine Soon" light on the vehicle's dashboard. This light is also known as the Malfunction Indicator Light (MIL). When this light illuminates, a Diagnostic Trouble Code is saved into the computer memory ready for the OBD II Scan Tool to read out the value.

Not all Diagnostic Trouble Codes illuminate the Check Engine light. Sometimes the vehicle needs to see an error a few times to ensure the problem isn't just a temporary glitch. Other times the computer determines the problem isn't emission related and the driver is not notified. Therefore, periodic checking of the Diagnostic Trouble Codes helps detect problems early before becoming more costly to repair. For instance, the computer may detect a problem with the automatic transmission but since the failure is not emission related the computer may not illuminate the Check Engine light. The transmission failure may also be difficult for the driver to detect just by driving the vehicle. Only a scan tool can reveal that a problem exists and the cause.

What are some uses for a scan tool?

The scan tool assists the home mechanic in repairing the automobile by providing access to the vehicle sensor readings. The scan tool displays, in real-time, the value measured by any sensor. For instance, if Diagnostic Trouble Code P0503 (vehicle speed sensor intermittent) is logged, a verification of the speed sensor using the scan tool may assist in confirming the failure.

Even if you don't repair the vehicle yourself, knowing the Diagnostic Trouble Code number before taking the vehicle in for repair makes you an informed consumer. If the Diagnostic Trouble Code indicates a faulty vehicle speed sensor, for example, and the mechanic talks about a major engine overhaul, you may want a second opinion before leaving the vehicle for repair.

Once the vehicle is repaired, the Diagnostic Trouble Code(s) can be erased and the Check Engine light extinguished using the scan tool. In states that require a smog check, an illuminated Check Engine light fails the emission test, even if the repaired vehicle might otherwise pass inspection.

Automobile enthusiasts use a scan tool to assist in obtaining the most performance possible from an engine. The scan tool Playback/Record feature can be used to record the engine performance as the vehicle travels down the drag strip. After the run, performance data is reviewed and compared to previous runs or other vehicles.

The Dyno features measures many parameters such as horsepower, torque, acceleration times, fuel economy and more.

OBD II Scan Tool

The OBD II Scan Tool connects to the vehicle's OBD II connector and obtains diagnostic information from the vehicle's computer systems.

The OBD II Scan Tool enables operations such as reading Diagnostic Trouble Codes, turning off the vehicle's Check Engine light, real-time sensor data acquisition, and more.

The PDA-Dyno™ is comprised of 5 components: the OBD II Interface Adapter, Software, OBD II cable and PDA data cable. (Palm handheld must be purchased separately).

PDA-Dyno™ and OBD II Scan Tool

The Software runs on a Palm handheld computer. The OBD II cable and the PDA data cable connect the Palm and the OBD II Interface Adapter together. Once connected, the OBD II software communicates through the OBD II Interface Adapter to the vehicle.



PDA-Dyno™ and OBD II Scan Tool

Specifications

The Interface Adapter and Software conforms to these specifications.

Table 1: Specifications

Input:	CAN, SAE J1850 VPW (Variable Pulse Width Modulation), SAE J1850 PWM (Pulse Width Modulation), ISO 9141-2, ISO 14230-4, and Keyword Protocol (KWP) 2000.
External Power:	None, draws power from vehicle.
Data Rates:	10.4K on VPW, 41.6K on PWM, and 10.4K on ISO/KWP.
Units of Measure:	English or Metric
Manual:	Electronic User Manual on CD-ROM with Diagnostic Trouble Code (DTC) descriptions.
Software:	Palm software on CD-ROM.
Weight:	4 oz
Dimensions:	4" long x 1.75" wide x .875 thick
Temperature:	32° to 158° F (0° to 70° C) non-condensing
Warranty:	Limited Lifetime Warranty. Damaged or modified products are not covered.

Warnings

WARNING

Do not operate the vehicle indoors. A running engine produces lethal carbon monoxide exhaust fumes that can seriously harm or kill you if inhaled. Only run the vehicle motor outdoors with proper ventilation. Most scan tool operations do not require a running motor.

WARNING

Do not attempt to operate or observe the scan tool while driving a vehicle. Driving requires the full attention of the driver. Operating or observing the scan tool will cause driver distraction and could cause a fatal accident.

WARNING

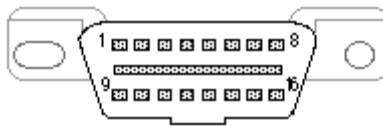
Ensure the Palm, cable, and interface adapter do not interfere with the vehicle controls. Always ensure the Palm, cable, and interface adapter are securely fastened out of the way. If the scan tool cannot be safely attached as to not interfere with the vehicle controls, then do not drive the vehicle with the interface adapter connected to the vehicle.

Supported Vehicles

The PDA-Dyno™ and OBD II Scan Tool supports all 1996 and newer vehicles incl. Domestic, European, and Asian. (supports all protocols: CAN, J1850 VPW, J1850 PWM, ISO-9141-2, and ISO-14230-4 (KWP 2000)).

Where is the vehicle's OBD II connector?

OBD II compliant vehicles have a 16-pin connector located underneath the dash near the driver's seat. Alternatively it may be behind ashtrays or concealed by an easily removed plastic cover, sometimes with the letters "OBD" stamped on the outside. (See File "OBD II Connector Locations" for the location of the OBD II connector on your vehicle.)



Vehicle OBD II Connector (Front View)

Supported Palm Handheld Devices

The PDA-Dyno™ and OBD II Scan Tool supports most Palm devices with operating system 3.0 or higher.

Palm OS version 3.x and later

1. Tap the Applications button in the lower-left corner of your screen. The applications launcher appears.
2. Tap the Menu button in the lower-left corner of your screen. A dropdown list appears.
3. Select Info. The Info screen appears.
4. Tap the Version button at the bottom of the screen. Your current Palm OS version appears at the top of the screen.

Abbreviations

Some item descriptions are abbreviated to fit within the Palm's screen.

OBD I – On-Board Diagnostics I

OBD II – On-Board Diagnostics II

OBDII Calif - OBD II (California ARB)

OBD Federal - OBD (Federal EPA)

No OBD - not intended to meet any OBD requirements.

OLoop NoSat - Open Loop – has not yet satisfied conditions to go closed loop.

CLoop O2 - Closed Loop – using oxygen sensor(s) as feedback for fuel control.

OLoop Drive - Open loop due to driving conditions (power enrichment, deceleration enrichment)

OLoop Fault - Open loop due to detected system fault.

CLoop Fault - Closed loop, but fault with at least one oxygen sensor – may be using single oxygen sensor control.

Upstream Cat - upstream of first catalytic converter.

Downstream Cat - downstream of first catalytic converter.

Atmosphere - atmosphere/off.

PTO NotActive – Power Take-Off Not Active

PTO Active – Power Take-Off Active

C - complete

I - incomplete

- - not supported

Acronyms and Definitions

A/F – Air Fuel

A/T – Automatic Transmission

Check Engine Light – also known as a MIL light.

CHT – Cylinder Head Temperature

Closed Loop – In closed loop operation the oxygen sensors are used to adjust the fuel mixture. See open loop.

DTC – Diagnostic Trouble Code

Dyno - Dynamometer

EBCM – Electronic Brake Control Module

EBTCM – Electronic Brake Traction Control Module

ECU – Electronic Control Unit (the vehicle's on-board computer)

EGR – Exhaust Gas Recirculation

EFI – Electronic Fuel Injection

EMR – Electronic Module Retard

ESC – Electronic Spark Control

EST – Electronic Spark Timing

EVAP – Evaporative Emission

Fuel Trim – engine computer function that keeps the air/fuel mixture close to ideal.

HC – Hydrocarbons

HEI – High Energy Ignition

HO2S – Heated Oxygen Sensor

Horsepower – a unit of measure to express the rate at which mechanical energy is expended.

HP – Horsepower

M/T – Manual Transmission

MAF – Mass Air Flow

MIL – Malfunction Indicator Light (i.e. “Check Engine” or “Service Engine Soon” light on the vehicle’s instrument panel).

NOx – Oxides of Nitrogen

O2 – Oxygen

Open Loop – used to describe the fuel mixture when the oxygen sensors are not being used, usually when the engine is cold or if a malfunction is detected. See closed loop.

PCM – Power Control Module

PID – Parameter ID is a number used to designate a particular vehicle sensor.

PTO – Power Take-Off

RPM – Revolutions per Minute

SAE – Society of Automotive Engineers

Scan Tool – a computer that reads out OBD II values from the vehicle.

Service Engine Soon – also known as a MIL light.

SFI – Sequential Fuel Injection

TBI – Throttle Body Injection

TCM – Transmission Control Module

TCS – Traction Control Switch

TFT – Transmission Fluid Temperature

Torque - Torque is a measure of how much a force acting on an object causes that object to rotate.

TP – Throttle Position

TPS – Throttle Position Sensor

VAC – Vacuum

VIN – Vehicle Identification Number

VSS – Vehicle Speed Sensor

Trademarks

Palm™, HotSync®, Graffiti®, and Palm OS™ are registered trademarks of Palm, Inc.

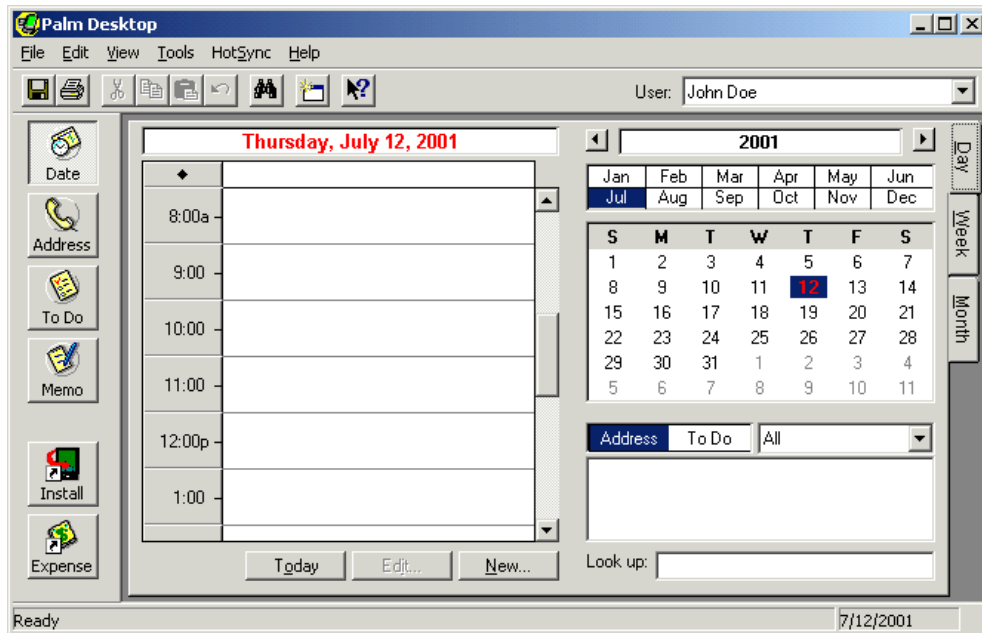
Chapter 2 : Loading Palm Software

Loading the Palm Software onto the Palm handheld is easy. This section shows you how.

Your Palm Desktop Software may look slightly different than shown here. Refer to your Palm documentation on loading software applications if you have trouble.

Step 1: Start Palm Desktop Software

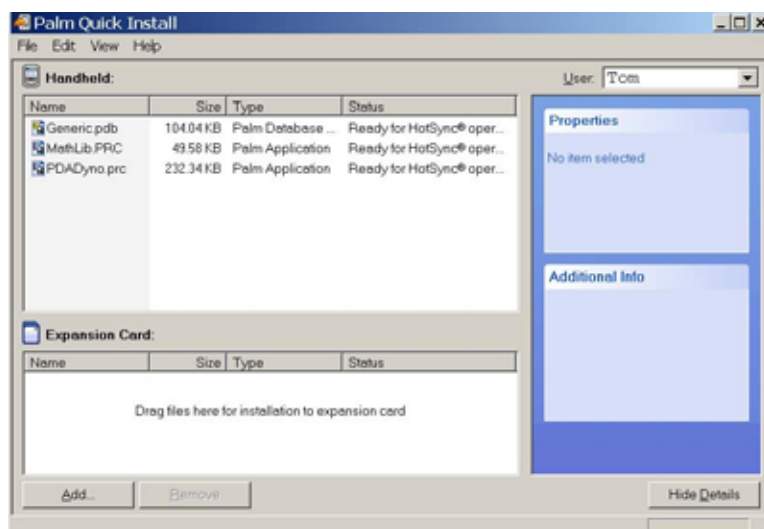
1. Start the Palm desktop software, included with your Palm, on your personal computer.



Palm Desktop Software

Step 2: Install Software

1. Press the Install button on the Palm Desktop software.
2. Press the Add... button on the Install Tool dialog and locate the DPADyno.prc and MathLib.prc file, located on the PDA-Dyno™ Software disk, or on the hard disk if the software was download from the web.
3. Optionally add one or more trouble code databases. It is recommends to install Generic.pdb, which has all the generic trouble codes common to all manufacturers. All databases have the file extension pdb.
4. Press the Done button on the dialog once the PDADyno.prc file and optional files are selected.



Install Tool Dialog

Step 3: Perform HotSync

1. Place the Palm into the HotSync cradle.
2. Press the HotSync button on the cradle base.
3. HotSync is complete, the software is loaded and ready for use on a live vehicle or standalone in demo mode (see Chapter 5).

Free Software Updates

Check the Nology website periodically to download free software updates at www.nology.com

Chapter 3 : Connect To The Vehicle

Connect to the Vehicle

- A** Plug the HotSync cable into the Palm handheld.
- B** Connect the HotSync cable to the OBD II adapter.
- C** Connect the OBD II cable to the OBD II adapter.

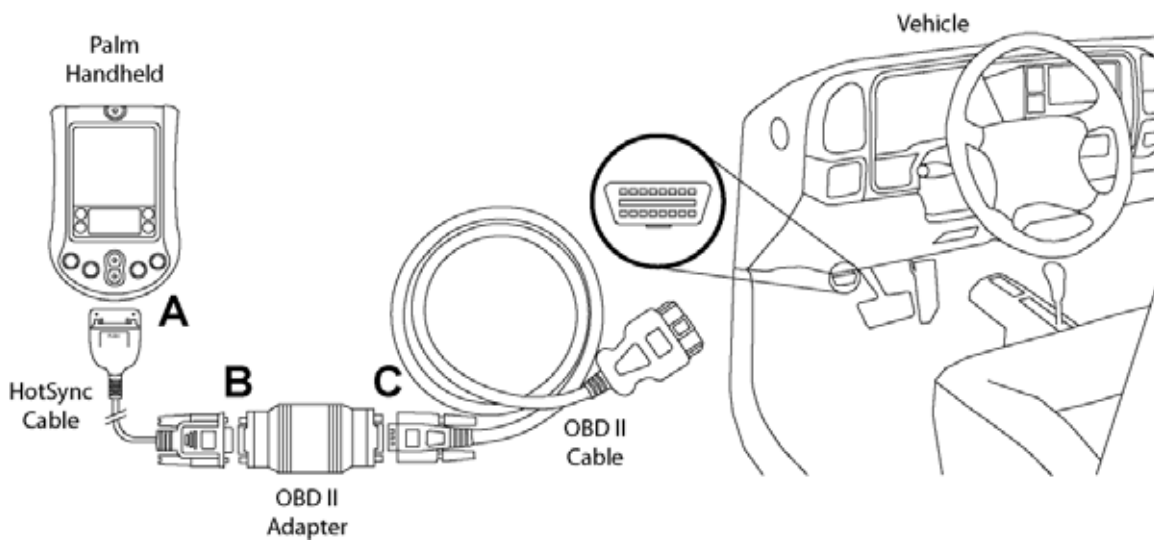


Figure 1: Dyno-Scan™ Connections

- D** Locate the OBD II connector on the vehicle. (16-pin connector under dash).
- E** Connect the OBD II Cable to the vehicle's OBD II connector. Ensure the connectors are fully engaged.

The vehicle does not have to be running.

Chapter 4 : Scan Tool Operation

The PDA-Dyno™ / OBD II Scan Tool software is designed for easy operation. This section shows how to operate the software and describes the features on each screen.

Not every vehicle is equipped with all sensor types supported by the scan tool. Therefore, the scan tool interrogates the vehicle and creates a custom list of sensors and options unique to the vehicle connected.



Ensure the Palm, cable, and OBD II adapter do not interfere with the vehicle controls. A cable dangling in front of the foot pedals, gear shifter, or steering wheel can interfere with vehicle operation and cause a fatal accident. Always ensure the Palm, cable, and OBD II adapter are securely fastened. If the scan tool cannot be safely attached as to not interfere with the vehicle controls, then do not drive the vehicle with the OBD II adapter connected to the vehicle.

Start Scan Tool Software

1. Start the scan tool software on the Palm by tapping the Scan Tool icon.



2. On the Connect screen, press the "Connect to Vehicle" button to connect to the vehicle. Pressing "Enter (No Connect)" enters the scan tool software without actually connecting to a vehicle. Useful to review previously recorded Scan Data files (see Record/Playback). To enable Demo mode see Chapter 5.

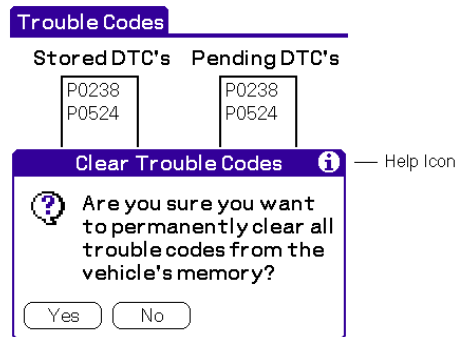


OBD II Connect

3. After a few seconds, the scan tool will detect the vehicle and display the General Info screen.

Palm Built-in Help

Most Palm popup dialogs contain user help. If help is available, in the upper right corner of the dialog will be a letter 'i' inside a circle. Tap the 'i' for help.



Help Icon

Preferences Dialog

Fast Sampling enables a faster than normal sampling frequency on some vehicles. On older versions of the OBD II Interface Adapter hardware this feature may not work. If you notice the live sensor monitoring doesn't function or the sensor measurements update sporadically, disable this feature.

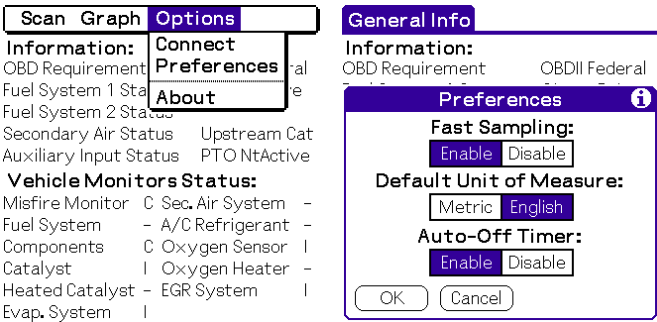
With Fast Sampling enabled, the scan tool cannot target a particular vehicle computer module. To obtain live sensor data from a specific computer module, turn Fast Sampling off. For instance, if a vehicle has two computer modules, 16 and 26, and both modules monitor engine RPM. With Fast Sampling enabled, the first module to respond, either 16 or 26, with the RPM data is displayed. With Fast Sampling disabled, the Palm software waits for exact module selected to respond before displaying the data. This is helpful for targeting measurement problems on a specific computer module.

The scan tool displays sensor measurements in either English or Metric units. The default units of measure is located on the Options | Preferences dialog. Not all sensors use English units of measure, in which case the Metric units are used. The software remembers the changes made within the Preferences dialog so every time the software is started the last settings are used.

The Palm normally turns off after a period of no user activity. The Auto-Off Timer feature prevents the Palm from powering off when actively querying the vehicle. Only when software is communicating with the vehicle is the disable Auto-Off actually enforced. Demonstration mode never utilizes the Auto-Off feature. The Disable Auto-Off Timer option is always deactivated when the scan tool software is exited.

NOTE

The Auto-Off feature prevents the Palm from powering down. If left unattended the Palm battery will run down and may lose all data stored on the device.



Preferences Dialog

General Information Screen

The General Information screen shows general information about the vehicle's test systems. If a system test is not supported by the vehicle, the display shows a dash '-' next to the status name.

Table 2: General Information Values

Status	Purpose	Possible Values
OBDD Requirement	OBDD requirement to which the vehicle is designed.	OBDD2 Calif OBDD2 Federal OBDD OBDD2 OBDD1 No OBDD EOBD EOBD OBDD2 EOBD OBDD EOBD OBDD OBDD2 JOBDD JOBDD OBDD2 JOBDD EOBD JOBDD EOBD OBDD2
Fuel System 1 Status	Status of the vehicle's fuel system 1.	OLoop NoSat CLoop O2 OLoop Drive OLoop Fault CLoop Fault -
Fuel System 2 Status	Status of the vehicle's fuel system 2.	OLoop NoSat CLoop O2 OLoop Drive OLoop Fault CLoop Fault -
Secondary Air Status	Status of the commanded secondary air system.	Upstream Cat Dnstream Cat Atmosphere -
Auxiliary Input Status	Status of the auxiliary input.	PTO NtActive PTO Active -
Vehicle Monitor Status (all)	Status of the vehicle test monitors, either complete (C), incomplete (I), or not supported (-).	C I -

The scan tool continually queries the vehicle to display the most current status values on the General Info screen.

General Info	
Information:	
OBD Requirement	OBDII Federal
Fuel System 1 Status	OLoop Drive
Fuel System 2 Status	-
Secondary Air Status	Upstream Cat
Auxiliary Input Status	PTO NtActive
Vehicle Monitors Status:	
Misfire Monitor	C Sec. Air System -
Fuel System	- A/C Refrigerant -
Components	C Oxygen Sensor I
Catalyst	I Oxygen Heater -
Heated Catalyst	- EGR System I
Evap. System	I

General Info Screen

Switching Screens

The scan tool has numerous screens. This procedure demonstrates how to switch between them.

- 1. Pressing the Palm's silk-screened dropdown menu button displays the dropdown menu.



Palm Silk-Screen Buttons

- 2. From the dropdown menu, any one of the other screens or options can be selected.

Scan		Dyno	Graph	Options
I	General Info	/G		
C	Trouble Codes	/T		Federal
F	Freeze Frame	/F		p Drive
F	Meter	/M		
S	List	/L		eam Cat
A	Graph	/A		NtActive
y	Dual Graph	/D		
N	Oxygen Sensors	/O		stem -
F	Open Scan Data			erant -
C	Power Off			ensor I
C	Find			eater -
H				m I
	Evap. System	I		

Figure 2: Dropdown Menu

- 3. The diagonal line and letter next to each screen name is called a shortcut. Instead of pressing the MENU button and selecting a screen from the dropdown menu, alternatively a Graffiti shortcut can be executed. In the Graffiti writing area, draw a diagonal line starting from the lower left and ending at the upper right (the shortcut command) followed by the letter of the screen. This enables quick transitions between screens.

See your Palm documentation for more information about Graffiti and Palm shortcuts.

Diagnostic Trouble Codes Screen

The Trouble Codes screen shows the pending and stored Diagnostic Trouble Codes (DTC), if any. The Trouble Codes screen continually scans for new DTCs, even if some DTCs are already shown.

Logged DTCs are displayed within a few seconds. If the vehicle's Check Engine or Service Engine Soon light is illuminated, a Stored DTC will be displayed. Pending DTCs do not necessarily indicate a faulty component/system. If the vehicles test results indicate a failure after additional driving, then the Check Engine light will be illuminated and a DTC will be set in the Stored DTC's column. (Must load separate DTC databases. These databases contain the textual code definitions for the numeric trouble codes.)

Two categories of trouble codes exist: Generic and enhanced. Generic codes are standardized and common to all vehicle manufacturers. Enhanced codes are not unique and may overlap with another manufacture, or even the same manufacturer. For instance, multiple definitions may exist for code P1234. Ford may define it as "Engine Oil Pressure Too Low", but Toyota's definition could mean something different like "System Voltage Unstable". The Trouble Codes screen reads and clears both generic and enhanced codes.

There are four types of trouble codes: P (Powertrain), B (Body), C (Chassis), and U (Network Communication). The scan tool reads and clears all P-codes and, depending on the vehicle, B, C, and U-codes as well².

1. Switch to the Trouble Codes screen as described in the section Switching Screens.

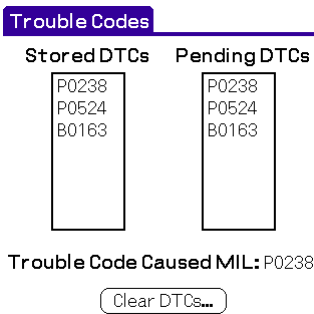


Figure 3: Trouble Codes Screen

2. If the vehicle has detected a Diagnostic Trouble Code(s) (DTC) they will be listed in either the Stored DTC's or Pending DTC's column. Not all Diagnostic Trouble Codes cause the MIL light (i.e. Check Engine) to illuminate.

If the MIL light is on, the Diagnostic Trouble Code that caused the light to illuminate is listed after the Trouble Code Caused MIL prompt. The freeze frame will contain a snapshot of the sensor values at the time the error occurred (see Freeze Frame Screen).

3. Press the Clear DTCs... button to clear all DTCs from the vehicle's memory. Wait a few seconds after pressing Yes on the Clear Trouble Codes screen for the scan tool to complete the clear command.
4. Pressing Yes will clear the DTC from the ECU. Once cleared, the error codes cannot be recovered. Clearing also turns off the vehicle's MIL (i.e. Check Engine) light and erases the

² Not all vehicles support retrieving and clearing B, C, and U-codes.

vehicle's freeze frame log. Sometimes the vehicle's ignition must be turned off and on again before the Check Engine light turns off.

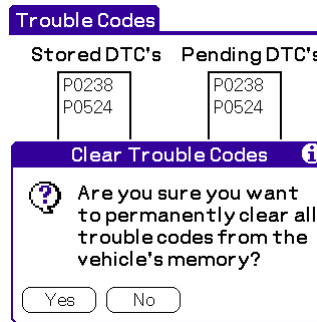


Figure 4: Clear Trouble Codes

5. Tapping a trouble code number will display the DTC Lookup dialog. This dialog will display a textual description for the numeric DTC value. The software does not contain a description for every possible trouble code. If the software cannot find a description, please refer to your vehicle's repair manual. See Appendix A: Diagnostic Trouble Codes (SAE J2012) for more information.

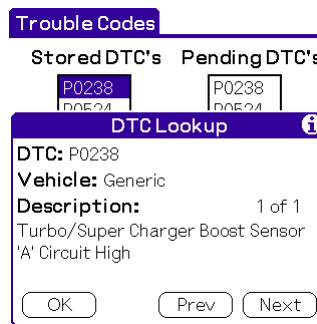


Figure 5: DTC Lookup Dialog

6. The DTC Lookup dialog searches through all installed DTC databases. If multiple DTC descriptions exist for a single code, scroll through all available definitions using the Next and Prev buttons until your vehicle make is displayed. The Vehicle and Description will automatically update as necessary when the Next/Prev buttons are pressed.

The "1 of 1" display shows the current DTC and total DTCs respectively. For instance, "1 of 2" means the dialog is displaying the first DTC definition out of the two possible. If multiple descriptions exist for a single vehicle manufacturer, consult your vehicle's repair manual to determine which definition matches your model car.

Freeze Frame Screen

The Freeze Frame screen displays the vehicle's freeze frame log. The sensor's units of measure, either English or Metric, are selected using the Preferences screen (see Preferences Dialog). When a Diagnostic Trouble Code occurs that illuminates the Check Engine light, the vehicle's computer saves the current values of the vehicle sensors at the instant the error occurred. If a freeze frame exists, it will display within a few seconds. This screen will remain blank if no freeze frame information is available from the vehicle.

1. Switch to the Freeze Frame screen as described in the section Switching Screens.

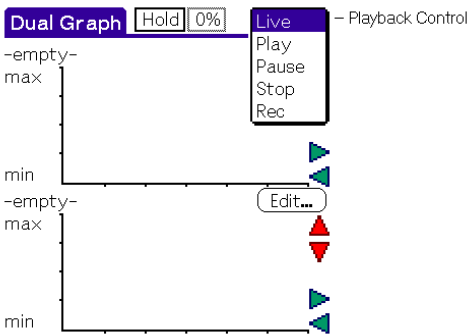
Freeze Frame		
DTC Causing Freeze	P0238	
Vehicle Speed	78	MPH
Intake Manifold Pressure	39.4	in.Hg
Long Term Fuel Trim-B2	9.4	%
Long Term Fuel Trim-B1	14.8	%
Engine Coolant Temp	237	deg F
Fuel System Status	OLoop NoSat	
Fuel Pressure (gage)	73.1	psig
Short Term Fuel Trim-B1	36.7	%
Engine RPM	11694	r/min
Calculated Load Value	74	%
Short Term Fuel Trim-B2	53.1	%

Figure 6: Freeze Frame Screen

- 2. Each vehicle supports a different complement of sensors. The freeze frame screen displays only sensors appropriate for the vehicle under test.

Record/Playback

The Graph, Dual Graph, List, and Meter screens can record and playback live sensor data. The Record/Playback control is located on the upper right drop down control.



Playback Control

The Record/Playback settings are:

- Live** – display live data.
- Play** – playback a previously recorded file.
- Pause** – pause a file during playback.
- Stop** – stop a playing file.
- Rec** – start recording.

There are two scan tool modes of operation: Live and Play. When the Record/Playback control is set to Live, and sensors values displayed are live from the vehicle. If the Record/Playback control is set to Play, Pause, Stop, or Rec the scan tool in Play mode.

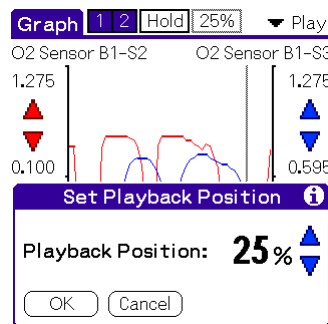
The recorded data is saved in a Scan Data file. The Scan Data files are managed via the Open Scan Data dialog located on the Scan | Open Scan Data menu option.

Once a file is opened, selecting Rec from the Record/Playback control will save the data into the currently opened file. Similarly, Play will playback the currently opened file.

New sensors must be selected while in Live mode. Once the mode has switched to Play mode, new sensors cannot be added; always switch to Live mode to add/remove sensors via the Sensor Select dialog.

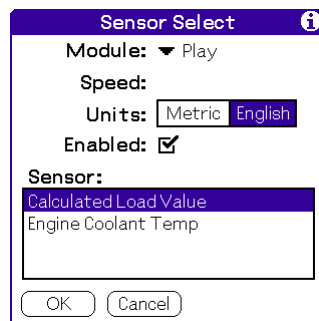
A Scan Data file may be played/recorded on any of the live data screens: Graph, Dual Graph, List, and Meter. The playback speed does not have the same time-base as the original recording. Therefore, playback will be faster than when recorded.

Playback position is controlled using the Playback Position control. Tap this control to adjust the playback position; 0% is the beginning of the file and 100% is the end. During playback, the Playback Position control updates to reflect the current playback position with the file.



Playback Position

A Scan Data file saves the list of sensors recorded. The Sensor Select dialog shows recorded sensors in the Parameter list box and the word “Play” is displayed as the Module. The Speed buttons are hidden when in play mode. See [Parameter Select Dialog](#) for more information.



Sensor Select (Play Mode)

A typical Scan Data record session proceeds as follows:

1. Switch to the Meter screen as described in the section Switching Screens.
2. Ensure the Record/Playback control is set to Live.
3. Create and open a Scan Data file by selecting Scan | Open Scan Data.

4. Press New, enter a file name, and press OK.
5. Highlight the file name within the Scan Data Files list box and press OK. A new file has been created and now open.
6. Press one of the Edit... buttons on the Meter screen to select a sensor to monitor.
7. Press OK to accept settings.
8. Press OK to start the sampling. The numeric display will update at the Speed interval selected.
9. Set the Record/Playback control to Rec to start recording.
10. Select Stop from the Record/Playback control after a few seconds of recording.
11. Select Play from the Record/Playback control to playback the previously recorded file.

Scan Tool Files

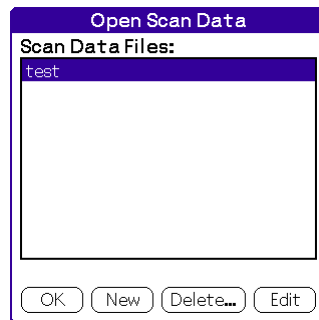
The Scan Tool feature uses one storage file:

Scan Data – stores data from the scan tool record operation.

The Scan Data files are managed using the Open Scan Data dialog. See Dyno Files for information regarding other file types.

Open Scan Data Dialog

The Scan Data files are managed using the Open Scan Data dialog. Creating, deleting, and editing of these files are performed from this screen.

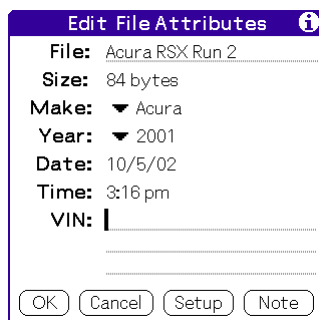


Open Scan Data Dialog

The Scan Data Files list box shows all the files currently stored on the device. If a file is already open, the list box will highlight the open file. A new file can be created by pressing the New button. The Delete... button will delete the actively selected file. And Edit will edit the files attributes.

Edit File Attributes Dialog

The Edit File Attributes screen edits a Scan Data file.



Edit File Attributes Dialog

The file attributes are:

File – file name.

Size – file size.

Make – make of the vehicle (e.g. Acura).

Year – year of the vehicle (e.g. 2001).

Date –date of file creation.

Time – time of file creation.

VIN – the VIN number of the vehicle.

Setup – the Dyno setup data used when the scan data file was recorded, if any.

Note – an optional text note.

The Note button displays the text note. The VIN field is where the vehicle identification number can be manually entered.

File Backup

All scan tool files are saved to the desktop computer upon HotSync. The file name on the desktop is the same name as on the Palm with the addition of three letters to designate the file type.

File Type	Appended Three Letters
Scan Data	-SD
Power Torque	-PT
Dyno Setup	-SE
Acceleration	-AC

For instance, a scan data file on the Palm named TestRun upon HotSync will save a file called TestRun-SD.pdb onto the desktop computer's hard drive in a directory called Backup.

To archive a file for a later date, copy the files from the Backup directory to a new directory. Once a copy has been made on the desktop, the file can be deleted from the Palm to free storage space. To reload the scan data file, HotSync the file onto the Palm as described in Chapter 2: Loading Palm Software.

Parameter Select Dialog

The PDA-Dyno™ Scan Tool software currently supports up to 79 separate live vehicle parameters on the Meter, Graph, Dual Graph, and List screens. The Parameter Select dialog selects a parameter to monitor, record, or playback.

Not every vehicle is equipped with all sensor types and not every vehicle supports every parameter type. Therefore, the scan tool interrogates the vehicle and creates a custom, alphabetical listing of the parameters unique to the vehicle and module selected.

Some vehicles are equipped with multiple computer modules. When switching between modules using the Module popup control, the Parameter list box will refresh showing only parameters supported by the selected module.

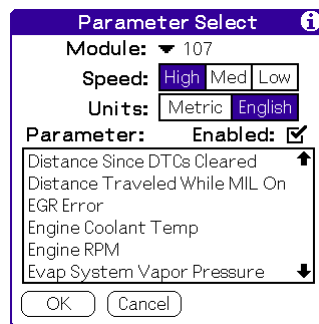


Figure 7: Parameter Select Dialog

Module – selects a vehicle's computer module. Some vehicles have more than one computer module. See Preferences Dialog for information on how the Fast Sampling setting affects data returned from a module.

Speed – selects the sampling speed for the sensor. High samples at up to 40mS³, Med is about 3 seconds, and Low is about every 10 seconds per sample.

Units – selects the units of measure for the sensor reading, either English or Metric.

Enabled – disables the sensor sampling when unchecked.

Parameter – selects the vehicle parameter to monitor. The list of sensors is dynamically created depending on the types of sensors supported by the vehicle. If the vehicle has more than one computer module, when the Module setting is changed the Parameter list is updated to reflect the sensors supported by that module.

³ Actual sampling speed is vehicle dependant.

Supported Parameters

The following is a list of all the live parameters supported by the software and a brief description of each parameter. Other non-live parameters, such as statuses or test results, are not listed here.

Air Flow Rate From MAF – indicates the airflow rate as measured by the mass air flow sensor.

Absolute Throttle Position – the absolute throttle position (not the relative or learned) throttle position. Usually above 0% at idle and less than 100% at full throttle.

Calculated Load Value – indicates a percentage of peak available torque. Reaches 100% at wide open throttle at any altitude or RPM for both naturally aspirated and boosted engines.

Engine Coolant Temp – engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor.

Engine RPM – displays the current engine revolutions per minute value.

Fuel Rail Pressure (gauge) – displays the fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure).

Ignition Timing Advance – ignition timing advance for #1 cylinder (not including mechanical advance).

Intake Manifold Pressure – indicates the manifold pressure derived from a Manifold Absolute Pressure sensor.

Long Term Fuel Trim-BX (up to 2) – indicates the correction being used by the fuel control system in both open and closed loop modes of operation.

O2 Sensor BX-SX (up to 8) – indicates the voltage for conventional 0 to 1V oxygen sensors. O2 sensors with a different full-scale voltage shall be normalized to this range or, if a wide range sensor, may use the wide range parameters instead.

Short Term Fuel Trim-BX (up to 2) – indicates the correction being used by the closed loop fuel algorithm. If the fuel system is open loop, 0% correction should be reported.

Time Since Engine Start – shall increment the time since the engine was started while the engine is running.

Vehicle Speed – displays the vehicle road speed.

Absolute Load Value – is the normalized value of air mass per intake stroke displayed as a percent.

Absolute Throttle Position (up to 3) – the absolute throttle position (not the relative or learned) throttle position. Usually above 0% at idle and less than 100% at full throttle.

Accelerator Pedal Position (up to 3) – the absolute pedal position (not the relative or learned) pedal position. Usually above 0% at idle and less than 100% at full throttle.

Ambient Air Temperature – displays the ambient air temperature.

Barometric Pressure – barometric pressure normally obtained from a dedicated barometric sensor. Note some whether services report barometric pressure adjusted to sea level. In these cases, the reported value may not match the displayed value.

Catalyst Temp Bank X – Sensor X (up to 4) – displays the catalyst substrate temperature.

Commanded EGR – display 0% when the EGR is commanded off, 100% when the EGR system is commanded on, and if the EGR is duty cycled somewhere between 0% and 100%.

Commanded Equivalence Ratio – fuel systems that use conventional oxygen sensor displays the commanded open loop equivalence ratio while the system is in open loop. Should report 100% when in closed loop fuel. To obtain the actual air/fuel ratio being commanded, multiply the stoichiometric A/F ratio by the equivalence ratio. For example, gasoline, stoichiometric is 14.64:1 ratio. If the fuel control system was command an equivalence ratio of 0.95, the commanded A/F ratio to the engine would be $14.64 * 0.95 = 13.9$ A/F.

Commanded Evaporative Purge – displays 0% when no purge is commanded and 100% at the maximum commanded purge position/flow.

Commanded Throttle Actuator – displays 0% when the throttle is commanded closed and 100% when the throttle commanded open.

Control Module Voltage – power input to the control module. Normally the battery voltage, less any voltage drop between the battery and the control module.

Distance Since DTCs Cleared – distance accumulated since DTCs where cleared with a scan tool.

Distance Traveled While MIL On – accumulates the vehicle distance traveled while the MIL light is illuminated.

EGR Error – error as percent of actual commanded EGR. Negative percent is less than commanded and positive is more than commanded.

Evap System Vapor Pressure – evaporative system vapor pressure normally obtained from a sensor located in the fuel tank.

Fuel Level Input – indicates the nominal fuel tank liquid fill capacity as a percent of maximum.

Fuel Rail Pressure – indicates the fuel rail pressure at the engine referenced to atmosphere (gauge pressure).

Fuel Rail Pressure Rel Manifold – displays the fuel rail pressure referenced to the manifold vacuum (relative pressure).

Intake Air Temperature – displays the intake manifold air temperature.

Minutes Run with MIL On – accumulated minutes of engine run time while the MIL light is on.

O2 Sensor BX-SX Wide Range mA (up to 8) – shows milliamps for linear or wide-ratio oxygen sensors.

O2 Sensor BX-SX Wide Range V (up to 8) – shows voltage for linear or wide-ratio oxygen sensors.

Relative Throttle Position – relative or “learned” throttle position.

Time Since DTCs Cleared – accumulated time since DTCs were cleared with a scan tool. Warm-ups Since DTCs Cleared – number of warm-up cycles since all DTCs were cleared. A warm-up is defined as the coolant temperature rising by at least 22°C (40°F) and the engine temperature reaches at a minimum 70°C (160°F) (60°C (140°F) for diesels).

Warm-ups Since DTCs Cleared – number of warm-up cycles since all DTCs were cleared via a scan tool. A warm-up is defined as the coolant temperature rising by at least 22°C (40°F) and the engine temperature reaches at a minimum 70°C (160°F) (60°C (140°F) for diesels).

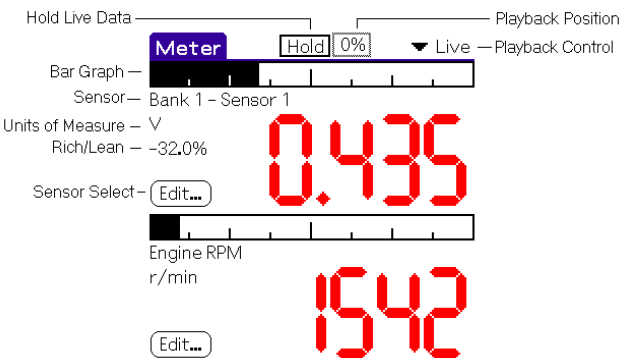
Meter Screen

The Meter screen displays real-time sensor readings from the vehicle in large, easy-to-read numbers for viewing at a distance. Up to two sensors can be monitored simultaneously. When switching between screens, the Meter screen remembers the last sensor(s) monitored.

Not every vehicle is equipped with all sensor types supported by the scan tool. Therefore, the scan tool interrogates the vehicle and creates a custom list of sensors and options unique to the vehicle connected. The scan tool supports the following sensor types:

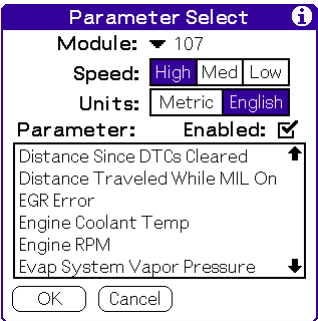
The Meter screen supports recording and playback of live data. See Record/Playback for more information.

1. Switch to the Meter screen as described in the section Switching Screens.



Meter Screen

2. Press one of the Edit... buttons to select a Parameter to monitor.



Parameter Select Dialog

3. The Parameter Select dialog contains numerous settings.

Module – selects a vehicle’s computer module. Some vehicles have more than one computer module. See Preferences Dialog for information on how the Fast Sampling setting affects data returned from a module.

Speed – selects the sampling speed for the sensor. High is about every .1 second, Med is about 3 seconds, and Low is about every 10 seconds.

Units – selects the units of measure for the sensor reading, either English or Metric.

Enabled – disables the sensor sampling when unchecked.

Parameter – selects the sensor parameter to monitor. The list of sensors is dynamically created depending on the types of sensors supported by the vehicle. If the vehicle has more than one computer module, when the Module setting is changed the sensor list is updated to reflect the sensors supported by that module.

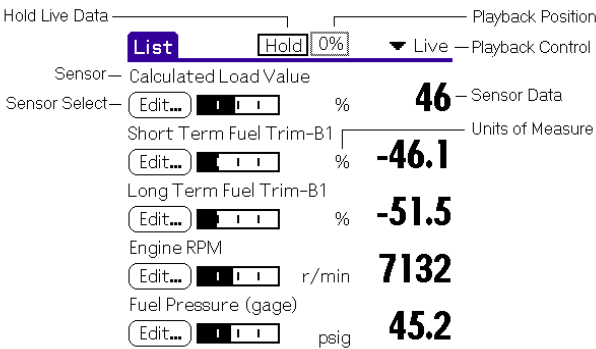
- 4. Press OK to accept settings or Cancel to revert to the previous screen.
- 5. Pressing OK starts the sensor reading display. The numeric display will update at the Speed interval selected.
- 6. The horizontal bar graph shows where the current sensor reading lies in relation to the absolute minimum and maximum sensor values. This is useful to determine if a sensor is pinned high, pinned low, or somewhere in between. The sensor name and units of measure are also displayed. For oxygen sensors, an additional rich/lean percentage is shown (-100% lean to 99.2% rich).
- 7. Pressing Hold temporarily suspends the Live display. Pressing Hold again resumes sensor sampling.

List Screen

The List screen displays real-time sensor readings from the vehicle in a list format. Up to five sensors can be monitored simultaneously. When switching between screens, the List screen remembers the last sensor(s) monitored.

The List screen supports recording and playback of live data. See Record/Playback for more information.

- 1. Switch to the List screen as described in the section Switching Screens.

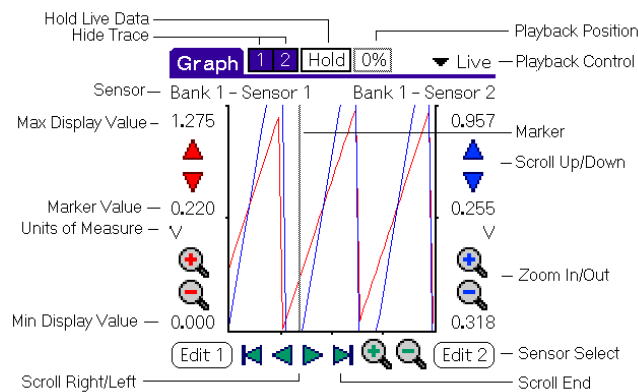


List Screen

2. Press one of the Edit... buttons to select a parameter to monitor as described in Parameter Select Dialog.
3. The horizontal bar graph for each sensor shows where the current sensor reading lies in relation to the absolute minimum and maximum sensor values.
4. Pressing Hold temporarily suspends the Live display. Pressing Hold again resumes sensor sampling.

Graph Screen

The Graph screen displays two real-time sensor measurements in a line graph format. When switching between screens, the Graph screen remembers the last sensors monitored.



Graph Screen

Each line on the graph is called a trace. The Hide Trace buttons 1 and 2 toggles between showing and hiding each trace. On Palm's with a black and white display, this makes it easy to differentiate between traces.

The Zoom In and Zoom Out buttons zoom the graph in out both vertically and horizontally. Each trace can be zoomed on the vertical axis independent of the other. The horizontal axis zooms both traces together. Alternative zoom controls are located off the Graph dropdown menu (e.g. Graph | Horizontal Zoom In).

The Up Scroll and Down Scroll arrows scroll a trace up and down when zoomed in. The Scroll Right and Scroll Left buttons scroll right and left. The Scroll End buttons scroll full right and full left.

When changing vertical zoom levels, the minimum and maximum display value labels change to reflect the new range. The current sensor reading will always display the correct value irrespective of the zoom range or graphical clipping.

Data values exceeding the vertical graph limits, either high or low, will be clipped at the vertical maximum/minimum graph value.

The graph control has a trace buffer that stores many pages of graph information. The scroll right and left button allow viewing all the data within the trace buffer.

TIP: The physical scroll up/down buttons on the bottom of every Palm scroll both traces in unison. If the Palm is equipped with a thumb scroll wheel, this too can vertically scroll both traces simultaneously.

Each vertical axis displays the minimum and maximum values. As the traces are scrolled and zoomed the min/max display values will update as required.

An exact measurement value for any data point along the trace can be shown using the marker, enabled by selecting Graph | Show Marker. The marker is a vertical dashed line within the graphing area. Using the Palm's stylus, drag the marker within the graph window. The data point under the marker for each axis will update as the marker is moved about the graphing area. To hide the marker, select Graph | Hide Marker.

With the marker displayed, pressing zoom in will center the horizontal axis display around the marker. This facilitates selecting a point of interest with the marker, then zooming in the horizontal axis to examine the data point.

If the Palm is equipped with a color screen, the scroll and zoom controls are color-coded: red for trace 1 and blue for trace 2.

The Sample Speed (High, Medium, or Low) for each trace must be the same on the Graph screen. The software enforces the sample speed.

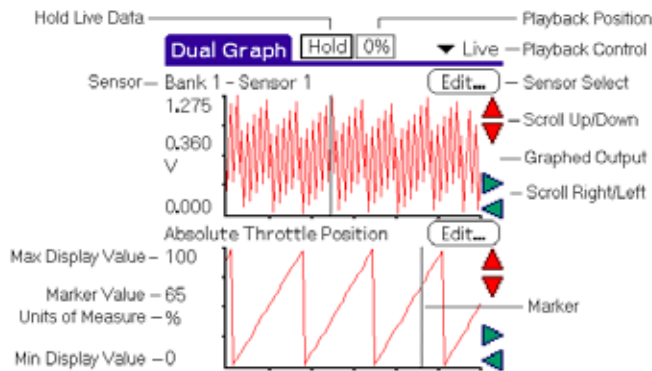
If only a single trace is desired, use trace 1 selected via the Edit 1 button. Trace 2 cannot be used by itself.

The Graph screen supports recording and playback of live data. See Record/Playback for more information.

1. Switch to the Graph screen as described in the section Switching Screens.
2. Press the Edit 1 buttons to select a sensor Parameter to monitor. (See Parameter Select Dialog)
3. Pressing Hold temporarily suspends the graphical Live display. Pressing Hold again resumes graphing.
4. Pressing the Zoom In and Zoom Out buttons zoom the traces in and out.
5. The Graph dropdown menu offers alternative horizontal and vertical zoom control for the line graphs. '1' designates trace 1 and '2' is trace 2.
6. Pressing the Scroll Right and Scroll Left buttons scroll through the trace buffer.
7. Pressing the Scroll Up and Scroll Down buttons scroll the trace up and down when zoomed in.

Dual Graph Screen

The Dual Graph screen displays two real-time sensor measurements in a line graph format. When switching between screens, the Dual Graph screen remembers the last sensors monitored.

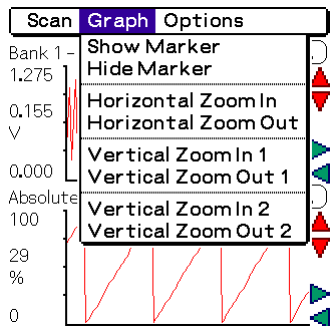


Dual Graph Screen

The graph controls support many features such as zoom and scroll. See Graph Screen for information on the usage of the graph controls. Unlike the Graph screen, the Sample Speed (High, Medium, or Low) for each trace can be selected independently.

The Dual Graph screen supports recording and playback of live data. See Record/Playback for more information.

1. Switch to the Dual Graph screen as described in the section Switching Screens.
2. Press one of the Edit... buttons to select a sensor to monitor. (See Parameter Select Dialog)
3. Pressing Hold temporarily suspends the graphical Live display. Pressing Hold again resumes graphing.
4. The Graph dropdown menu offers horizontal and vertical zoom control for the line graphs. '1' designates the upper graph and '2' is the lower.



Graph Menu

Horizontal zoom-in/out operates the both upper and lower graphs together. Zoom-in expands the graphical output and zoom-out compresses it. Vertical zoom-in/out operates upper and lower graphs independently.

Oxygen Sensors

The Oxygen Sensor screen displays the vehicle's oxygen sensor test results. The results displayed here are measured by the vehicle's on-board computer (ECU) and not the scan tool. These are not live values but instead the results of the ECU's last O2 sensor test. For live O2 sensor readings, refer to any of the live sensor screens such as Graph Screen.

For these test results to be accurate, the Oxygen Sensor test on the Vehicle Monitor Status section should be 'C' for complete.

Not all vehicles support the Oxygen Sensors screen. If the vehicle or a particular sensor does not support this feature, the screen list will be blank.

The test values measured by the ECU correspond to certain attributes of the O2 sensor voltage over time waveform as shown in Figure 8: Oxygen Screens Screen Test Values.

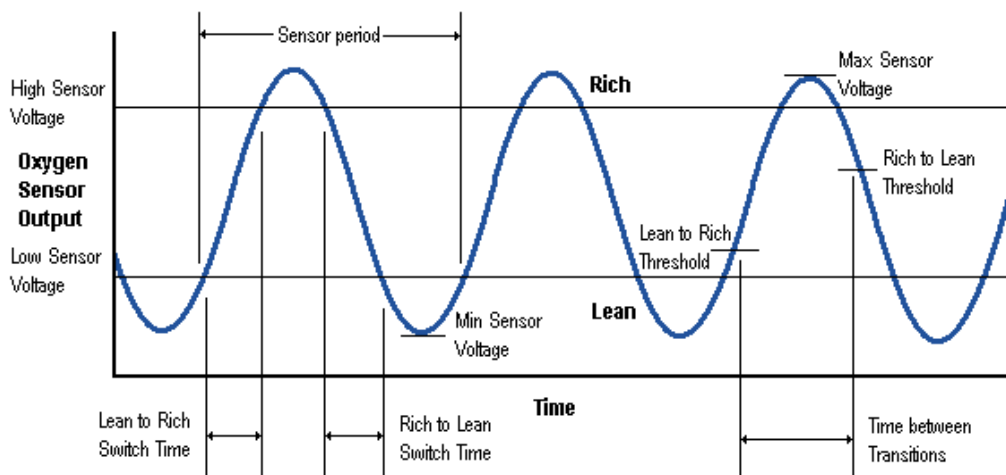


Figure 8: Oxygen Screens Screen Test Values

1. Switch to the Oxygen Sensors screen as described in the section Switching Screens.
2. The Sensor Position indicates which oxygen sensor's test results are being displayed.

Oxygen Sensors		
Sensor Position: Bank 2 - Sensor 2		
Sensor period	4.7	sec
Max sensor voltage	0.585	V
Lean to rich switch time	0.47	sec
High sensor voltage	0.585	V
Lean to rich threshold	0.585	V
Time between transitions	4.7	sec
Rich to lean switch time	0.47	sec
Rich to lean threshold	0.585	V
Low sensor voltage	0.585	V
Min sensor voltage	0.585	V
Next Sensor		

Figure 9: Oxygen Sensors Screen

3. Tap any line with a note icon to display the O2 Limits screen showing the test result and test limits applied to result.

Name – test name.

- Measured** – the ECU measured test result.
- Minimum Limit** – the minimum test limit for which the measured test result is compared.
- Maximum Limit** – the maximum test limit for which the measured test result is compared.

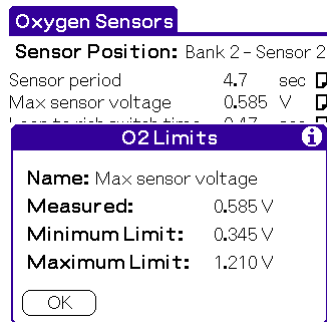


Figure 10: O2 Limits Dialog

- 4. Pressing the Next Sensor button displays the results for the next sensor, if any. When the last sensor is reached, the display wraps around to the first sensor.

Code Search Screen

The Code Search screen provides an interactive search of diagnostic trouble codes (DTCs). Generic codes and enhanced codes have predefined numeric ranges as shown in Table 3: DTC Groupings.

Table 3: DTC Groupings

ISO/SAE Controlled (Generic)	Manufacturer Controlled (Enhanced)
P0000 to P0999	P1000 to P1999
P2000 to P2999	P3000 to P3399
P3400 to P3999	

Generic codes are applicable to all vehicle makes and models. Generic definitions are only displayed if the Generic database is selected. Enhanced codes are stored within each manufacturer’s unique DTC database (e.g. Ford.pdb).

When selecting an enhanced code, use the enhanced code ranges and select a manufacturer database. For codes within the generic ranges, select the Generic database.

- 1. Switch to the Code Search screen as described in the section Switching Screens.

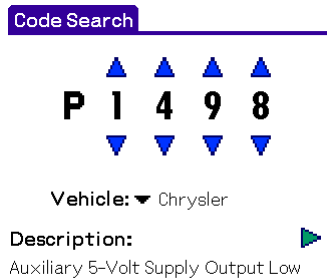


Figure 11: Code Search

2. Select a vehicle manufacturer using the Vehicle popup list. The list shows all installed vehicle DTC databases.
3. Select the code by using the up and down arrows above each number. The Description field will automatically update with each new code selected.
4. If a code cannot be located for that manufacturer, try selecting a different manufacturer. If a description cannot be located, the software recommends referring to the repair manual. Note, not every DTC number is a valid trouble code.
5. If a duplicate definition from the same vehicle manufacturer is found, right/left arrows will display. Pressing the arrows traverses through all multiple definitions for the selected vehicle manufacturer. To determine which duplicate definition is applicable to your vehicle, refer to your vehicle's repair manual.

Quit Application

Pressing the home silkscreen button exits the software and returns to the Palm desktop.



Quit Application

Chapter 5 : Dyno Operation

Dyno operations require driving the vehicle while the Palm software records performance data. For increased safety, the software does not require user intervention during the test runs. All data is recorded for later analysis and audible tones are used to convey instructions to the user while driving.

All Dyno features are accessed via the Dyno menu bar.

WARNING

Never race or exceed the posted speed limit while on public highways. Some Dyno operations require accelerating to high speeds. Use closed course raceway when performing dyno measurements.

WARNING

Do not attempt to operate or observe the PDA while driving a vehicle. Driving requires the full attention of the driver. Operating or observing the PDA while driving will cause driver distraction and could cause a fatal accident.

WARNING

Ensure the Palm, cable, and interface adapter do not interfere with the vehicle controls. Always ensure the Palm, cable, and interface adapter are securely fastened out of the way. If the scan tool cannot be safely attached as to not interfere with the vehicle controls, then do not drive the vehicle with the interface adapter connected to the vehicle.

Theory of Operation

A dynamometer, or dyno for short, is used to measure engine power. Automotive dynos are either crankshaft dynos or chassis dynos.

Crankshaft dynos measure the power directly at the crankshaft, or flywheel, and is not affected by transmission and axle powertrain losses. Vehicle manufacturers always list crankshaft power. Chassis dynos test the power delivered to the wheels, not just the crankshaft. As such, the power figures measured are always less than with a crankshaft dyno since the powertrain robs the vehicle of some power.

PDA-Dyno™

The PDA-Dyno™ is a newly developed device designed to compute engine power, acceleration times, fuel economy, and more.

The PDA-Dyno™ test the vehicle in a completely real world situation that includes powertrain losses, drag from disk brakes and wheel bearings, tire rolling resistance, etc. – everything a vehicle sees on the street.

Aerodynamic drag is compensated for within the calculations. So, whether your vehicle has the aerodynamics of a Truck or a Ferrari, the power calculations will correct for losses due to wind drag.

Weather conditions affect the output of an internal combustion motor. The method to compensate for various weather conditions is to apply a correction factor to the results. The industry standard is the SAE J1349 Correction Factor. The Palm Dyno software applies this correction factor to all horsepower and torque measurements.

By applying these correction factors to the dyno results, a vehicle dyno'd in Denver on a hot day will give the same results as a chilly day in San Diego. Using the Palm Dyno, measurements generated are comparable with one another the world over.

The dyno runs are performed in a single gear. Any gear will work, but results that are more accurate are obtained if the software has an increased measurement time. For instance, the time to accelerate from 1000 RPM to 5000 RPM in 1st gear is a shorter duration than it would be in 3rd gear. Therefore, using 2nd or 3rd gear for dyno runs offers longer test durations for greater accuracy.

Extensive comparison testing on the Dynojet chassis dynamometer has shown the Palm Dyno to be extremely accurate.

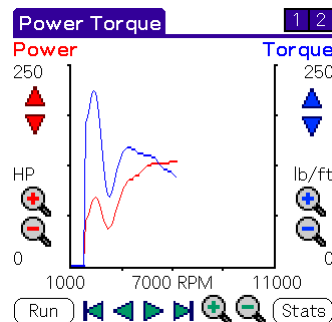
Automatic Transmissions

All automatic transmissions are equipped with a torque converter. The torque converter slips under certain conditions, such as at low RPM and under heavy load. When the torque converter slips, the gear ratio is artificially lower and the RPM higher than if the torque converter is locked up in direct drive. At cruising speeds and low load requirements, the torque converter locks up for increased fuel economy.

Under heavy acceleration, the slippage is greatest below 3000 RPM. Above 3000 RPM the slippage is still evident but to a lesser degree.

A slipping torque converter is perfectly normal. Automatic transmissions are designed to slip, which gives them some advantages when towing a heavy load. However, this causes an anomaly known to all chassis dynos as well as the PDA-Dyno™.

Since the RPM is higher than normal while the torque converter is slipping, the power vs. torque graphs may display an unnaturally large swell below 3000 RPM. This is normal and all dynos exhibit this behavior. The power torque figures above 3000 RPM are the real numbers used for evaluation.



Power Torque Run Automatic Transmission

Fast Sampling

The Fast Sampling preference on the Preferences dialog must be enabled to achieve accurate dyno operation. Ensure this option is selected whenever using Dyno features.

Dyno Files

The Dyno features use three storage files:

Power Torque – stores Power and Torque run data.

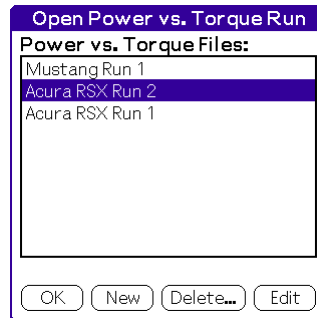
Acceleration – stores Acceleration run data.

Dyno Setup – stores Dyno setup variables such as vehicle weight, elevation, humidity, etc.

See Scan Tool Files and File Backup for information regarding other file types and desktop backup.

Open Power vs. Torque Run Dialog

The Power Torque files are managed using the Open Power vs. Torque Run dialog. From this dialog, Power Torque files can be created, deleted, and edited.

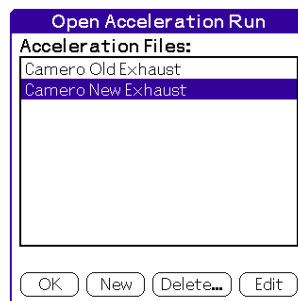


Open Power vs. Torque Run Dialog

The Power vs. Torque Files list box shows all the files currently stored on the device. If a file is already open, the list box will initially highlight the currently open file. A new file can be created by pressing the New button. The Delete... button will delete the actively highlighted file. To modify the file attributes, highlight a file and press the Edit button to display the Edit File Attributes dialog. Pressing OK will open the currently selected file and dismiss the Open Power vs. Torque dialog.

Open Acceleration Run Dialog

The Acceleration files are managed using the Open Acceleration Run dialog. From this dialog, Acceleration files can be created, deleted, and edited.

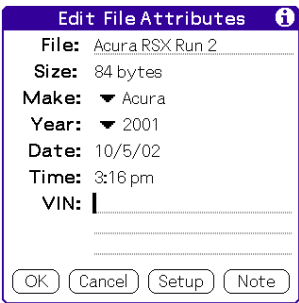


Open Acceleration Run Dialog

See Open Power vs. Torque Run Dialog for more information regarding managing files.

Edit File Attributes Dialog

The Edit File Attributes dialog edits a Power Torque or Acceleration file.



Edit File Attributes Dialog

- File** – file name.
- Size** – file size.
- Make** – make of the vehicle (e.g. Acura).
- Year** – year of the vehicle (e.g. 2001).
- Date** –date of file creation.
- Time** – time of file creation.
- VIN** – the VIN number of the vehicle.
- Note** – an optional text note.

The Note button displays the text note for viewing. The Setup button displays the Dyno Setup Used On Run dialog, which shows the Dyno Setup parameters used for the run. Pressing OK will save the file attributes or Cancel will discard any changes.

Dyno Setup Used On Run Dialog

This shows the Dyno Setup parameters used on a run. Parameters such as vehicle weight, elevation and humidity are all saved at the time the run was performed. If a run has not been performed yet, the File name field will be blank and all other entries are set to default values.



Dyno Setup Used On Run Dialog

The parameters on this screen are not tied to the Dyno Setup file. If the user modifies the Dyno Setup file attributes, the software will not update all files. Dyno Setup files can be updated without affecting any stored Dyno Setup Used On Run values.

Open Dyno Setup Dialog

The Dyno Setup files are managed using the Open Dyno Setup dialog. From this dialog Dyno Setup files can be created, deleted, and edited.



Edit Dyno Setup Dialog

See Open Power vs. Torque Run Dialog for more information regarding managing files.

Edit Dyno Setup Dialog

The Edit Dyno Setup dialog edits the attributes within a Dyno Setup file. The file attributes are:



Edit Dyno Setup Dialog

File – file name.

Weight – weight of the vehicle including passengers.

Gear Ratio – the overall gear ratio of the vehicle, which includes transmission and axle.

Tire Diameter – the vehicle tire diameter.

Temp – current outside temperature.

Elevation – current elevation.

Humidity – current outside humidity.

Pressure – current outside altimeter pressure available from www.nws.noaa.gov. Altimeter pressure is different than barometric pressure.

Drag – drag coefficient of vehicle.

Frontal Area – the frontal area of the vehicle.

Note – an optional text note.

Pressing OK will save the new Dyno Setup or Cancel will discard any changes. The Note button allows entering a text note.

The software measures the gear ratio and computes the tire diameter for you. See Gear Ratio Screen for more information.

Common drag coefficients are usually in the range of 0.25 to 0.45 – the lower the number the less wind drag on the vehicle.

Frontal areas are usually in the range of 17 to 28 sq. ft – the lower the number the less frontal area. Smaller vehicles have lower frontal areas.

To get an understanding for these numbers, Table 4: Drag Coefficients and Frontal Areas list the values for different vehicle types.

Table 4: Drag Coefficients and Frontal Areas

Vehicle	Drag Coefficient	Frontal Area (sq/ft)
1999 Chevy Cavalier	0.36	21.5
2000 Ford Taurus	0.32	23.7
2000 Chevy Silverado 1500 2WD	0.45	28.0
2000 Ford Explorer	0.45	25.8
2002 Honda Civic Hatchback	0.36	20.5
2000 Acura Integra	0.32	20.1
2000 Volvo S40	0.32	20.9
2000 Chrysler LHS	0.31	23.1

See Appendix on Vehicle Specifications for more information on your specific vehicle make and model.

Calculation of Frontal Area

Frontal area can be calculated for any car. The frontal area represents the front projection area of the vehicle. If one takes a picture of the front of a vehicle, it is the area included in the outline. Use the following to calculate:

1. Calculate the area of a rectangle, which would encompass the front of the vehicle (multiply width by the height).
2. Adjust the figure obtained above for areas not included, such as top rounded corners, etc. Typical adjusting values are 85 percent for cars, and 100 percent for trucks.

Gear Ratio Screen

The Gear Ratio screen measures the overall gear ratio of the vehicle and computes a tire diameter given the tire size.

Gear Ratio

Width	Ratio	Rim Dia
▼ 205	▼ 65	▼ 15

Tire Diameter: 25.49 inches

Compute Tire Diameter

Status: Idle

Gear Ratio: 8.278

Measure Gear Ratio

RPM	MPH (c)	MPH (r)
6618	60.6	60

Gear Ratio Screen

Tire Diameter

Computing a tire diameter requires entering the tire size. Most passenger car tire sizes are listed as width, ratio, and rim diameter (e.g. 205/65 R15).

Enter the tire size using the Width, Ratio, and Rim Dia drop down lists. Once entered, press the Compute Tire Diameter to calculate the tire diameter in inches.

Many large truck tire sizes are sized differently. These tires are listed as diameter, width, and rim diameter (e.g. 31x10.5 R16). In this case, the first number can be used as the tire diameter in inches (e.g. 31").

Measuring Overall Gear Ratio

Measuring the vehicle gear ratio involves keeping the vehicle speed steady while the software computes an overall gear ratio. The gear ratio changes with each transmission gear. Therefore, the software computes one overall gear ratio per gear ratio run (e.g. overall gear ratio for 2nd gear). The overall gear ratio is the combination of the transmission gear ratio and the final drive gear ratio.

The Status field lists the current status of the gear ratio run, either:

Idle – no data is being gathered.

Countdown to Start – shows the number of seconds until data collection begins.

Collecting Data – vehicle data is being recorded.

A tire diameter must be entered in the Tire Diameter field before performing a gear ratio run. Pressing Measure Gear Ratio will start a gear ratio run.

Once a tire diameter has been entered, pressing the Measure Gear Ratio button starts the 10-second countdown. During this time, get the vehicle moving in the gear the run is going to be performed in (e.g. 2nd gear). The vehicle RPM should be between 3000 and 4000 RPM for best results. Once the gear and RPM is achieved, keep the throttle steady.

At the end of the countdown the Palm will beep. After the beep continue to keep the throttle steady until a second beep is heard (about 10 seconds). The second beep indicates the gear ratio run is over.

Bring the vehicle to a complete stop. The measured overall gear ratio will be displayed.

Confirming Gear Ratio Result

At the bottom of the Gear Ratio screen are three live values:

RPM – current measured RPM.

MPH (c) – computed MPH using RPM.

MPH (r) – real MPH measured via the vehicle's on-board computer.

MPH (c) will only display if values are entered into the Tire Diameter and Gear Ratio fields. If the computed MPH and real MPH values match throughout the RPM range then the gear ratio and tire diameter values are correct for this vehicle. If they do not match, adjust the Gear Ratio field up or down until the computed and real MPH match.

A computed verses real MPH check in a single gear might be:

1. Keep a steady speed at 2000 RPM.
2. Confirm the computed and real MPH values match.
3. Increase speed to a steady 4000 RPM.
4. Confirm the computed and real MPH values match.

WARNING

Always have a passenger confirm the computed and real MPH readings match. Driving requires the full attention of the driver. Operating or observing the scan tool while driving will cause driver distraction and could cause a fatal accident.

Computing a gear ratio requires an accurate speedometer. If the vehicle's tire size is either smaller or larger than stock and the speedometer has not been recalibrated to the new wheel size, then the computed gear ratio will be incorrect. This will make the horsepower and torque figures higher or lower than expected.

Using Tire Diameter and Gear Ratio

Once the tire diameter and gear ratio is obtained, the values are entered into the Gear Ratio and Tire Dia fields within a Dyno Setup file. See Edit Dyno Setup Dialog for more information.

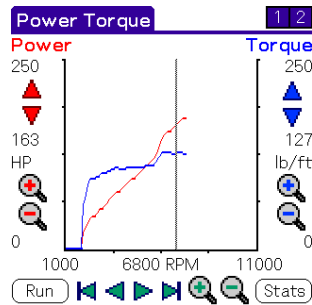
TIP: To have multiple gear ratio setups for the same car, create a Dyno Setup files for each gear with file names like Ford1stGear, Ford2ndGear, etc.

Automatic Transmissions

The Palm software uses the gear ratio on the power torque run, which is performed under heavy acceleration. The gear ratio run, however, is performed under essentially a no-load condition where the torque converter slippage is negligible. Therefore, for automatic transmissions the measured gear ratio may have to be lowered by 5 to 15% to account for the torque converter slippage. Otherwise the power and torque curves will show lower than expected values.

Power vs. Torque Screen

The Power vs. Torque screen analyzes power and torque data gathered from a vehicle run.



Power vs. Torque Screen

The power torque graph shows horsepower/torque over engine RPM. The vertical axis 1 shows the power from 0 to 500 HP. The vertical axis 2 shows the torque from 0 to 500 torque. The horizontal axis shows the engine RPM from 1000 to 11000 RPM.

The graph control support many features such as zoom and scroll. See Graph Screen information on the usage of the graph control.

The Run button is for starting a dyno run. After a run is complete, the Stats button shows horsepower and torque statistics on the Power Torque Statistics dialog.

Previously stored Power Torque files can be viewed on the Power vs. Torque Screen by opening the file using the Open Power vs. Torque dialog located on the menu bar at Dyno | Open Power vs. Torque.

Power Torque Run Dialog

Two files are required to perform a power torque run: a Power Torque file and a Dyno Setup file. The Power Torque file is the destination for the collected run data. The Dyno Setup file provides the operational parameters used by the software to compute horsepower and torque.

The File and Setup popup triggers are initially set to the currently open files, if any. Tap the File popup trigger to select the Power Torque file. Then tap the Setup popup trigger to select the Dyno Setup file. The Overwrite File checkbox prevents the software from asking the user to overwrite a file when the run starts. Any previous run data stored within the file is lost when a file is overwritten.

The Power Torque Run dialog acquires the data from a power torque run.

Figure 12: Power Torque Run

The Status field shows the current status of the run, either:

Idle – no data is being gathered.

Countdown to Start – shows the number of seconds until data collection begins.

Collecting Data – vehicle data is being recorded.

Performing a Power Torque Run

Before the run, ensure that the cables and interface adapter are securely fastened out of the way and do not interfere with vehicle operation.

Once the Power Torque file and Dyno Setup files are selected, pressing the Start Power Torque button starts the 10-second countdown.

During the countdown, get the vehicle moving in the gear the run is going to be performed in (e.g. 2nd gear). The vehicle RPM during the countdown should be under 2000 RPM, the throttle steady.

At the end of the countdown, the Palm will beep. At the beep, floor the accelerator to achieve maximum acceleration.

Once maximum RPM is reached, either shift to the next higher gear or decelerate the vehicle by letting off the accelerator. Bring the vehicle to a complete stop and press the Start Power Torque button again to stop data collection.

Press the OK button to dismiss the Power Torque Run dialog and view the power/torque graph.

Power Torque Run Do's and Don'ts

For safety and the most accuracy from the Dyno software, please follow the guidelines below.

Keep your attention on driving – the software is designed to require no user intervention when a run is performed. Start the power torque run while the vehicle is stopped. During the countdown, accelerate to the correct gear and starting RPM. Audible tones signal when to accelerate the vehicle.

Consistent vehicle setup – use the same tire pressure, same number of passengers, no A/C, windows rolled up, low beams on, radio and other accessories off.

Automatic transmission – most automatic transmissions will want to downshift under hard acceleration. Experiment with higher starting RPM or roll the throttle on slowly at first to prevent a downshift.

Manual transmission – ensure the clutch is completely out when the data collection starts.

Steady throttle – do not “blip” the throttle during the countdown period. Keep the throttle and RPM steady.

Maximum throttle – keep the throttle fully floored until maximum RPM is achieved. A dip in the RPM will cause the power torque graphs to terminate early⁴.

Dyno setup – try to obtain current temperature, humidity, elevation, and altimeter pressure before each day of runs.

Head/Tail Wind – a windy day will skew the power/torque results higher or lower depending on the wind direction. A relatively calm day provides the best results.

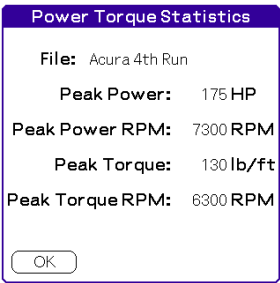
Level Ground – an uphill climb will make the power/torque lower and conversely a downhill run will have higher than expected values. Level ground provides the best results.

⁴ Use common sense – let off the accelerator if something gets in the way of the vehicle.

Heat soak – repeated runs will cause the intake manifold temperature to increase. Hot air is less dense and causes a reduction in power/torque. Just note that the first run may have slightly higher values than subsequent runs if performed back-to-back.

Power Torque Statistics Dialog

The Power Torque Statistics dialog calculates the peak horsepower and torque at RPM values for the currently opened Power Torque file.



Power Torque Statistics Dialog

File – Power Torque file name.

Peak Power – peak horsepower output during the run.

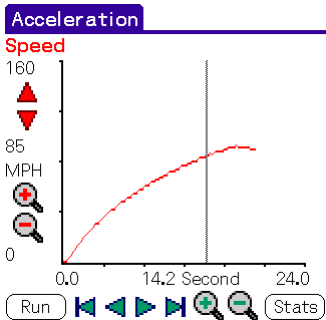
Peak Power RPM – the RPM peak power was achieved.

Peak Torque – peak torque output during during the run.

Peak Torque RPM – the RPM peak torque was achieved.

Acceleration Screen

The Acceleration screen analyzes acceleration data gathered from a vehicle run.



Acceleration Screen

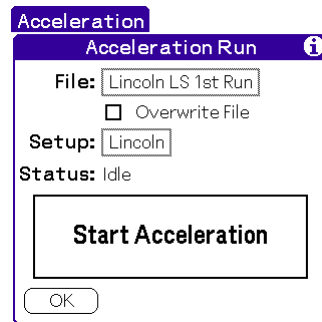
The acceleration graph shows vehicle speed over time. The vertical axis shows the vehicle speed from 0 to 160 MPH. The horizontal axis shows the time from 0 to 24 seconds.

The graph control support many features such as zoom and scroll. See Graph Screen information on the usage of the graph control.

The Acceleration Run dialog is used to perform an acceleration run.

Acceleration Run Dialog

The Acceleration Run dialog acquires the data from an acceleration run.



Acceleration Run Dialog

Two files are required to perform a power torque run: an Acceleration file and a Dyno Setup file. The Acceleration file is the destination for the collected run data. The Dyno Setup file provides the operational parameters used by the software to compute a 1/4-mile horsepower figure.

The File and Setup popup triggers will be initially set to the currently open files, if any. Tap the File popup trigger to select the Acceleration file. Then tap the Setup popup trigger to select the Dyno Setup file. The Overwrite File checkbox prevents the software from asking the user to overwrite a file when the run starts. Any previous run data stored within the file is lost when a file is overwritten.

The Status field shows the current status of the run, either:

Idle – no data is being gathered.

Waiting to Start – waiting for the vehicle to start moving.

Collecting Data – vehicle data is being recorded.

Performing an Acceleration Run

Before the run, ensure that the cables and interface adapter are securely fastened out of the way and do not interfere with vehicle operation.

Once the Acceleration file and Dyno Setup files are selected, press the Start Acceleration button.

The acceleration run is performed from a standing start. Once the Status field says Waiting to Start, the Palm software is waiting for the vehicle to start accelerating. The acceleration run does not use RPM like a power torque run does. Therefore, while waiting to accelerate you may rev the motor or do whatever else you think will achieve the quickest acceleration time.

As you accelerate down the track, you may stop the acceleration run at different data points depending on the data you're trying to collect.

60 MPH – if acceleration stops after 60 MPH, the 0-60 time will be computed.

1/8 mile – if acceleration stops after 1/8 mile, this time and speed is computed.

1/4 mile – if acceleration stops after 1/4 mile, the 1/4-mile time and speed is computed. In addition, a 1/4-mile horsepower value is computed.

Its best to accelerate slightly beyond a data point to ensure the software captures the vehicle passing through the data point at maximum acceleration. For instance, don't stop at exactly 60 MPH. Accelerating just beyond 60 will achieve the best results.

Bring the vehicle to a complete stop and press the Start Acceleration button again to stop data collection. Press the OK button to view the acceleration graph.

Acceleration Run Do's and Don'ts

For safety and best accuracy from the Dyno software, follow the guidelines below.

Keep your attention on driving – the software is designed to require no user intervention when a run is performed.

Consistent vehicle setup – use the same tire pressure, same number of passengers, no A/C, windows rolled up, low beams on, radio and other accessories off.

Head/Tail Wind – a windy day will skew the acceleration results higher or lower depending on the wind direction. A relatively calm day provides the best results.

Level Ground – going uphill will make the acceleration lower and conversely a downhill run will have higher than expected values. Level ground provides the best results.

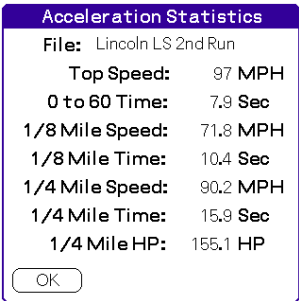
Heat soak – repeated runs will cause the intake manifold temperature to increase. Hot air is less dense and causes a reduction in power/torque. Just note that the first run may have slightly faster values than subsequent runs if performed back-to-back.

Accelerate Just Past Data Point - accelerate slightly beyond a data point (e.g. 60 MPH, 1/8 mile, or 1/4 mile) to ensure the software captures the vehicle passing through the data point at maximum acceleration

If the vehicle's tire size is either smaller or larger than stock and the speedometer has not been recalibrated to the new wheel size, then the computed acceleration figures will be incorrect. Acceleration runs require an accurate speedometer.

Acceleration Statistics

The Acceleration Statistics screen computes times and horsepower values based upon how fast the vehicle accelerates.



Acceleration Statistics	
File:	Lincoln LS 2nd Run
Top Speed:	97 MPH
0 to 60 Time:	7.9 Sec
1/8 Mile Speed:	71.8 MPH
1/8 Mile Time:	10.4 Sec
1/4 Mile Speed:	90.2 MPH
1/4 Mile Time:	15.9 Sec
1/4 Mile HP:	155.1 HP
OK	

Acceleration Statistics Dialog

File – Acceleration run file name.

Top Speed – maximum speed achieved during the run.

0 to 60 Time – how fast in seconds the vehicle traveled from 0 to 60 MPH.

1/8 Mile Speed – how fast in MPH the vehicle was traveling at the 1/8-mile mark.

1/8 Mile Time – time in seconds, the vehicle traveled a 1/8-mile.

1/4 Mile Speed – how fast in MPH the vehicle was traveling at the 1/4-mile mark.

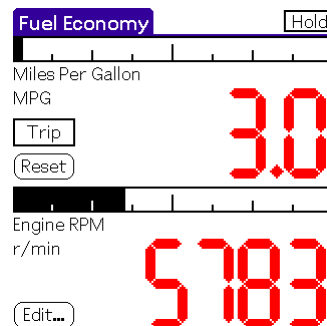
1/4 Mile Time – time in seconds, the vehicle traveled a 1/4-mile.

1/4 Mile HP – a rough calculation of horsepower based strictly on 1/4-mile time and vehicle weight.

N/A will be displayed if the vehicle didn't travel far enough to compute the statistic.

Fuel Economy

The Fuel Economy screen computes instantaneous and trip MPG. Another sensor can also be monitored along with Fuel Economy.



Fuel Economy Screen

Pressing the Trip button toggles the Miles Per Gallon view between instantaneous mode and trip mode. Highlighted Trip button indicates the trip mode. Un-highlighted the MPG display is in instantaneous mode. The software remembers the trip MPG when switching between screens and even when the software exits. The only time the trip MPG is reset is when the Fuel Economy screen Reset button is pressed⁵. However, the trip MPG is only updated while the Fuel Economy screen is being displayed. When instantaneous mode is being viewed, the trip mode MPG is still being updated.

The instantaneous mode MPG mode is very dynamic. As the accelerator is depressed, the fuel economy will immediately drop. Coasting down hill may result in a very high MPG. A "----" indicates the MPG is higher than 99.9 MPG.

The fuel economy feature is only available on vehicles equipped with a mass airflow sensor (MAF). The Sensor Select screen has a list of sensors supported by your vehicle.

⁵ Loss of Palm battery power will reset the trip mode MPG to 0.

Chapter 6 : Demo Mode

Demonstration mode simulates all vehicle data. This mode facilitates learning about the scan tool features without connecting to a live vehicle.

Enable Demo Mode

Demo mode is enabled from the Connect screen.

1. Select the "Connect to Vehicle Demo" checkbox on the Connect screen.



Connect to Vehicle Demo

2. Press the "Connect to Vehicle" button. With demo mode enabled, all vehicle data is simulated – even if the scan tool is connected to a vehicle.

Chapter 7 : PDB Export

The PDB Export Windows application converts Palm scan tool databases into a CSV file suitable for import into a spreadsheet application such as Microsoft Excel. The file format is a comma delimited file and, as such, almost any spreadsheet package should be able to import the data. Once the data is imported into the spreadsheet, numerous data manipulations are possible such as graphing data.

The PDB Converter application will run on Windows 95, 98, ME, NT, 2000, and XP.

Recorded Data

Recorded data can be a Scan Data file, Power Torque File, or an Acceleration file. During a HotSync, recorded files are copied to the desktop in a Palm directory called Backup. Usually this directory is contained under the Program Files directory. The file will have a PDB (Palm Database) extension. For instance, on one machine the Backup directory might be located at:

c:\Program Files\Sony Handheld\Backup

PDB Export

The PDB Export application is a single executable: PDBExport.exe. The program does not need to be installed.

The PDB Export controls are:

Open File – opens a Palm PDB file.

Convert – converts the selected PDB file.

Close – closes the application.



PDB Export

1. Start PDB Export by double clicking PDBExport.exe.
2. Press the Open File button to open a Palm PDB file.
3. Using the Open dialog find and select the PDB file to convert (e.g. TestFile.pdb).
4. Press the Convert button to convert the Palm PDB to a CSV file.
5. Using Save As dialog, select directory and file name for the CSV file (TestFile.csv).
6. Open the CSV file with your spreadsheet application.

CSV File Format

The CSV file is a tabular format of data placed into rows and columns. The first row contains basic file information as saved on the Palm:

File Name – the name of the PDB file.

Make – make of the vehicle.

Year – the year of the vehicle.

VIN – the optional VIN number field.

Note – the optional note field.

	A	B	C	D	E	F
1	TestFile	Acura	2000	VIN	This is a note.	
2	Sample	PID	Value Metric	Units Metric	Value English	Units English
3	1	13	255	km/h	158	MPH
4	2	11	6	kPaA	1.8	in. hg
5	3	13	13	km/h	8	MPH
6	4	11	20	kPaA	5.9	in. hg
7	5	13	27	km/h	17	MPH
8	6	11	34	kPaA	10.1	in. hg
9	7	13	41	km/h	25	MPH
10	8	11	48	kPaA	14.2	in. hg
11	9	13	55	km/h	34	MPH
12	10	11	62	kPaA	18.4	in. hg
13	11	13	69	km/h	43	MPH

CSV File in Excel

The second row contains the column headings for the scan data. Metric values are always included in the CSV file, however if there is no corresponding English units of measure for a sensor then no conversion is shown.

Sample – the sample number.

PID – the sensor PID (see **Error! Reference source not found.**).

Value Metric – the sensor value in Metric units.

Units Metric – the Metric units of measure.

Value English – the sensor value in English units.

Units English – the English units of measure.

Sensor PID

A sensor PID is a numbers that corresponds to a sensor. The following table maps PIDs to sensors.

Table 5: PID to Parameter Mapping

PID	Parameter	PID	Parameter
4	Calculated Load Value	44	Commanded EGR
5	Engine Coolant Temp	45	EGR Error
6	Short Term Fuel Trim-B1	46	Evaporative Purge
7	Long Term Fuel Trim-B1	47	Fuel Level Input
8	Short Term Fuel Trim-B2	48	Warm-ups Since DTCs Cleared
9	Long Term Fuel Trim-B2	49	Distance Since DTCs Cleared
10	Fuel Rail Pressure (gauge)	50	Evap System Vapor Pressure
11	Intake Manifold Pressure	51	Barometric Pressure
12	Engine RPM	52	O2 Sensor B1-S1 Wide Range mA
13	Vehicle Speed	53	O2 Sensor B1-S2 Wide Range mA
14	Ignition Timing Advance	54	O2 Sensor B1-S3 Wide Range mA
15	Air Intake Temperature	55	O2 Sensor B1-S4 Wide Range mA
16	Air Flow Rate from MAF	56	O2 Sensor B2-S1 Wide Range mA
17	Absolute Throttle Position	57	O2 Sensor B2-S2 Wide Range mA
20	O2 Sensor B1-S1	58	O2 Sensor B2-S3 Wide Range mA
21	O2 Sensor B1-S2	59	O2 Sensor B2-S4 Wide Range mA
22	O2 Sensor B1-S3	60	Catalyst Temp Bank 1 – Sensor 1
23	O2 Sensor B1-S4	61	Catalyst Temp Bank 2 – Sensor 1
24	O2 Sensor B2-S1	62	Catalyst Temp Bank 1 – Sensor 2
25	O2 Sensor B2-S2	63	Catalyst Temp Bank 2 – Sensor 2
26	O2 Sensor B2-S3	66	Control Module Voltage
27	O2 Sensor B2-S4	67	Absolute Load Value
31	Time Since Engine Start	68	Commanded Equivalence Ratio
33	Distance Traveled While MIL On	69	Relative Throttle Position
34	Fuel Rail Pressure Rel Manifold	70	Ambient Air Temperature
35	Fuel Rail Pressure	71	Absolute Throttle Position B
36	O2 Sensor B1-S1 Wide Range V	72	Absolute Throttle Position C
37	O2 Sensor B1-S2 Wide Range V	73	Accelerator Pedal Position D
38	O2 Sensor B1-S3 Wide Range V	74	Accelerator Pedal Position E
39	O2 Sensor B1-S4 Wide Range V	75	Accelerator Pedal Position F
40	O2 Sensor B2-S1 Wide Range V	76	Commanded Throttle Actuator
41	O2 Sensor B2-S2 Wide Range V	77	Minutes Run with MIL On
42	O2 Sensor B2-S3 Wide Range V	78	Time Since DTCs Cleared
43	O2 Sensor B2-S4 Wide Range V		

Chapter 8 : Troubleshooting

Troubleshooting contains solutions to common problems encountered with the scan tool.

Scan Tool Connects but No Sensor Data

If no Live data is displayed in the Meter, Graph, Dual Graph, or List screens, try the following remedies:

1. Disable the Fast Sampling option in the Options | Preferences dialog.
2. Ensure the Enabled checkbox is selected on the Sensor Select dialog.

No Communication (Scan Tool)

If the No Communication (Scan Tool) dialog appears, this means the Palm cannot communicate with the vehicle. Try the following remedies:

1. Ensure the vehicle ignition is turned on. Vehicle does not have to be running; however it can be.
2. Try pressing the "Connect to Vehicle" button again.
3. Ensure the OBD II Interface Adapter is securely plugged into the vehicle's OBD II connector.
4. Ensure the PDA cable is securely plugged into the Palm.
5. Ensure the vehicle is OBD II compliant (see Supported Vehicles).
6. Ensure your Palm has fresh batteries, or if the Palm is rechargeable, that the batteries are fully charged. Extremely low batteries may fail to communicate reliably.
7. Ensure no vehicle fuses are blown. Interface adapter power is derived from the vehicle and a blown fuse could prevent power from reaching the scan tool.
8. If using a Handspring, try removing the springboard module.

No Communication (Vehicle)

If the No Communication (Vehicle) dialog appears, see No Communication (Scan Tool).

Lost Communication

If the Lost Communication dialog appears, this means the Palm initially established communication but subsequently lost it. Try the following remedies:

1. Ensure the OBD II Interface Adapter is securely plugged into the vehicle's OBD II connector.
2. Ensure the pda cable is securely plugged into the Palm.
3. Ensure your Palm has fresh batteries, or if the Palm is rechargeable, that the batteries are fully charged. Extremely low batteries may fail to communicate reliably.

Incompatible OS Version

Your Palm operating system must be at version 3.0 or higher to run the software. Upgrade your Palm OS or purchase a newer Palm handheld.

Serial Port in Use

Another application erroneously left the serial port open. Follow these steps to remedy the problem.

1. Gently press the Reset button on the back of the Palm using the end of bent paper clip. Do NOT press any other buttons when the Reset button is pressed. See your Palm documentation for more information about resetting your Palm.
2. Restart the PDA-Dyno™ application. The serial port should now be ready for use.

Oxygen Sensor Screen is Blank

Not all vehicles support the features provided by the Oxygen Sensor screen. If the vehicle does not support this feature, the data for the screen will be blank.

Freeze Frame Screen is Blank

If the vehicle has not detected a failure that caused the Check Engine to illuminate, the data for the Freeze Frame screen will be blank.

Clearing Codes Did Not Work or MIL Didn't Turn Off

There are a few possible causes for the check engine light not to extinguish or the DTCs to reappear on the scan tool. First, if the problem is not fixed the DTC may return immediately for problems such as misfires, open or shorted sensors, etc. Second, some vehicles can't be running when the memory is cleared. In these cases, ensure the key is on but the engine is off before attempting to clear the memory. And last, some vehicles require, after the codes are cleared, for the ignition key to be turned off and then on again before the MIL light actually turns off.

Appendix A: Diagnostic Trouble Codes (SAE J2012)

A Diagnostic Trouble Code (DTC) is a 5-digit value starting with a letter.

The DTC's codes listed here are generic to all manufacturers. These generic Diagnostic Trouble Codes are those codes where industry uniformity has been achieved. However, each vehicle manufacturer may optionally create new codes beyond the generic ones. The OBD II Scan Tool can read these enhanced manufacturer specific codes. However, if you obtain a code not listed here, use your vehicle's repair manual to determine the meaning of the DTC.

The scan tool software has a built-in lookup for all the trouble codes listed here. Generic.pdb has all the definitions listed here.

Diagnostic Trouble Code Format Structure

The Diagnostic Trouble Code numbering follows a standardized structure. All Diagnostic Trouble Codes have a letter followed by a 4-digit number (e.g. P1234). The first letter indicates the type of code:

P = Powertrain

C = Chassis

B = Body

U = Network Communication

The remaining 4-digit number specifies the problem within that system.

P00XX Fuel and Air Metering and Auxiliary Emission Controls

P0010	"A" Camshaft Position Actuator Circuit	(Bank 1)
P0011	"A" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 1)
P0012	"A" Camshaft Position - Timing Over-Retarded	(Bank 1)
P0013	"B" Camshaft Position - Actuator Circuit	(Bank 1)
P0014	"B" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 1)
P0015	"B" Camshaft Position - Timing Over-Retarded	(Bank 1)
P0020	"A" Camshaft Position Actuator Circuit	(Bank 2)
P0021	"A" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 2)
P0022	"A" Camshaft Position - Timing Over-Retarded	(Bank 2)
P0023	"B" Camshaft Position - Actuator Circuit	(Bank 2)
P0024	"B" Camshaft Position - Timing Over-Advanced or System Performance	(Bank 2)
P0025	"B" Camshaft Position - Timing Over-Retarded	(Bank 2)
P0030	HO ₂ S Heater Control Circuit	(Bank 1 Sensor 1)
P0031	HO ₂ S Heater Control Circuit Low	(Bank 1 Sensor 1)
P0032	HO ₂ S Heater Control Circuit High	(Bank 1 Sensor 1)
P0033	Turbo Charger Bypass Valve Control Circuit	
P0034	Turbo Charger Bypass Valve Control Circuit Low	
P0035	Turbo Charger Bypass Valve Control Circuit High	
P0036	HO ₂ S Heater Control Circuit	(Bank 1 Sensor 2)
P0037	HO ₂ S Heater Control Circuit Low	(Bank 1 Sensor 2)
P0038	HO ₂ S Heater Control Circuit High	(Bank 1 Sensor 2)
P0042	HO ₂ S Heater Control Circuit	(Bank 1 Sensor 3)
P0043	HO ₂ S Heater Control Circuit Low	(Bank 1 Sensor 3)
P0044	HO ₂ S Heater Control Circuit High	(Bank 1 Sensor 3)
P0050	HO ₂ S Heater Control Circuit	(Bank 2 Sensor 1)
P0051	HO ₂ S Heater Control Circuit Low	(Bank 2 Sensor 1)
P0052	HO ₂ S Heater Control Circuit High	(Bank 2 Sensor 1)
P0056	HO ₂ S Heater Control Circuit	(Bank 2 Sensor 2)
P0057	HO ₂ S Heater Control Circuit Low	(Bank 2 Sensor 2)
P0058	HO ₂ S Heater Control Circuit High	(Bank 2 Sensor 2)

P0062	HO ₂ S Heater Control Circuit	(Bank 2 Sensor 3)
P0063	HO ₂ S Heater Control Circuit Low	(Bank 2 Sensor 3)
P0064	HO ₂ S Heater Control Circuit High	(Bank 2 Sensor 3)
P0065	Air Assisted Injector Control Range/Performance	
P0066	Air Assisted Injector Control Circuit or Circuit Low	
P0067	Air Assisted Injector Control Circuit High	
P0070	Ambient Air Temperature Sensor Circuit	
P0071	Ambient Air Temperature Sensor Range/Performance	
P0072	Ambient Air Temperature Sensor Circuit Low Input	
P0073	Ambient Air Temperature Sensor Circuit High Input	
P0074	Ambient Air Temperature Sensor Circuit Intermittent	
P0075	Intake Valve Control Solenoid Circuit	(Bank 1)
P0076	Intake Valve Control Solenoid Circuit Low	(Bank 1)
P0077	Intake Valve Control Solenoid Circuit High	(Bank 1)
P0078	Exhaust Valve Control Solenoid Circuit	(Bank 1)
P0079	Exhaust Valve Control Solenoid Circuit Low	(Bank 1)
P0080	Exhaust Valve Control Solenoid Circuit High	(Bank 1)
P0081	Intake valve Control Solenoid Circuit	(Bank 2)
P0082	Intake Valve Control Solenoid Circuit Low	(Bank 2)
P0083	Intake Valve Control Solenoid Circuit High	(Bank 2)
P0084	Exhaust Valve Control Solenoid Circuit	(Bank 2)
P0085	Exhaust Valve Control Solenoid Circuit Low	(Bank 2)
P0086	Exhaust Valve Control Solenoid Circuit High	(Bank 2)

P01XX Fuel and Air Metering

P0100	Mass or Volume Air Flow Circuit	
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	
P0102	Mass or Volume Air Flow Circuit Low Input	
P0103	Mass or Volume Air Flow Circuit High Input	
P0104	Mass or Volume Air Flow Circuit Intermittent	
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit	
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance Problem	
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	
P0109	Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent	
P0110	Intake Air Temperature Circuit	
P0111	Intake Air Temperature Circuit Range/Performance Problem	
P0112	Intake Air Temperature Circuit Low Input	
P0113	Intake Air Temperature Circuit High Input	
P0114	Intake Air Temperature Circuit Intermittent	
P0115	Engine Coolant Temperature Circuit	
P0116	Engine Coolant Temperature Circuit Range/Performance Problem	
P0117	Engine Coolant Temperature Circuit Low Input	
P0118	Engine Coolant Temperature Circuit High Input	
P0119	Engine Coolant Temperature Circuit Intermittent	
P0120	Throttle/Pedal Position Sensor/Switch A Circuit	
P0121	Throttle/Pedal Position Sensor/Switch A Circuit Range/Performance Problem	
P0122	Throttle/Pedal Position Sensor/Switch A Circuit Low Input	
P0123	Throttle/Pedal Position Sensor/Switch A Circuit High Input	
P0124	Throttle/Pedal Position Sensor/Switch A Circuit Intermittent	
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	
P0126	Insufficient Coolant Temperature for Stable Operation	
P0127	Intake Air Temperature Too High	
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	
P0130	O ₂ Sensor Circuit	(Bank 1 Sensor 1)
P0131	O ₂ Sensor Circuit Low Voltage	(Bank 1 Sensor 1)
P0132	O ₂ Sensor Circuit High Voltage	(Bank 1 Sensor 1)
P0133	O ₂ Sensor Circuit Slow Response	(Bank 1 Sensor 1)
P0134	O ₂ Sensor Circuit No Activity Detected	(Bank 1 Sensor 1)
P0135	O ₂ Sensor Heater Circuit	(Bank 1 Sensor 1)
P0136	O ₂ Sensor Circuit Malfunction	(Bank 1 Sensor 2)
P0137	O ₂ Sensor Circuit Low Voltage	(Bank 1 Sensor 2)
P0138	O ₂ Sensor Circuit High Voltage	(Bank 1 Sensor 2)
P0139	O ₂ Sensor Circuit Slow Response	(Bank 1 Sensor 2)

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P0140	O2 Sensor Circuit No Activity Detected	(Bank 1 Sensor 2)
P0141	O2 Sensor Heater Circuit	(Bank 1 Sensor 2)
P0142	O2 Sensor Circuit Malfunction	(Bank 1 Sensor 3)
P0143	O2 Sensor Circuit Low Voltage	(Bank 1 Sensor 3)
P0144	O2 Sensor Circuit High Voltage	(Bank 1 Sensor 3)
P0145	O2 Sensor Circuit Slow Response	(Bank 1 Sensor 3)
P0146	O2 Sensor Circuit No Activity Detected	(Bank 1 Sensor 3)
P0147	O2 Sensor Heater Circuit	(Bank 1 Sensor 3)
P0148	Fuel Delivery Error	
P0149	Fuel Timing Error	
P0150	O2 Sensor Circuit	(Bank 2 Sensor 1)
P0151	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 1)
P0152	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 1)
P0153	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 1)
P0154	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 1)
P0155	O2 Sensor Heater Circuit	(Bank 2 Sensor 1)
P0156	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 2)
P0157	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 2)
P0158	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 2)
P0159	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 2)
P0160	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 2)
P0161	O2 Sensor Heater Circuit	(Bank 2 Sensor 2)
P0162	O2 Sensor Circuit Malfunction	(Bank 2 Sensor 3)
P0163	O2 Sensor Circuit Low Voltage	(Bank 2 Sensor 3)
P0164	O2 Sensor Circuit High Voltage	(Bank 2 Sensor 3)
P0165	O2 Sensor Circuit Slow Response	(Bank 2 Sensor 3)
P0166	O2 Sensor Circuit No Activity Detected	(Bank 2 Sensor 3)
P0167	O2 Sensor Heater Circuit	(Bank 2 Sensor 3)
P0168	Fuel Temperature Too High	
P0169	Incorrect Fuel Composition	
P0170	Fuel Trim	(Bank 1)
P0171	System too Lean	(Bank 1)
P0172	System too Rich	(Bank 1)
P0173	Fuel Trim Malfunction	(Bank 2)
P0174	System too Lean	(Bank 2)
P0175	System too Rich	(Bank 2)
P0176	Fuel Composition Sensor Circuit	
P0177	Fuel Composition Sensor Circuit Range/Performance	
P0178	Fuel Composition Sensor Circuit Low Input	
P0179	Fuel Composition Sensor Circuit High Input	
P0180	Fuel Temperature Sensor A Circuit	
P0181	Fuel Temperature Sensor A Circuit Range/Performance	
P0182	Fuel Temperature Sensor A Circuit Low Input	
P0183	Fuel Temperature Sensor A Circuit High Input	
P0184	Fuel Temperature Sensor A Circuit Intermittent	
P0185	Fuel Temperature Sensor B Circuit	
P0186	Fuel Temperature Sensor B Circuit Range/Performance	
P0187	Fuel Temperature Sensor B Circuit Low Input	
P0188	Fuel Temperature Sensor B Circuit High Input	
P0189	Fuel Temperature Sensor B Circuit Intermittent	
P0190	Fuel Rail Pressure Sensor Circuit	
P0191	Fuel Rail Pressure Sensor Circuit Range/Performance	
P0192	Fuel Rail Pressure Sensor Circuit Low Input	
P0193	Fuel Rail Pressure Sensor Circuit High Input	
P0194	Fuel Rail Pressure Sensor Circuit Intermittent	
P0195	Engine Oil Temperature Sensor	
P0196	Engine Oil Temperature Sensor Range/Performance	
P0197	Engine Oil Temperature Sensor Low	
P0198	Engine Oil Temperature Sensor High	
P0199	Engine Oil Temperature Sensor Intermittent	

P02XX Fuel and Air Metering

P0200	Injector Circuit
P0201	Injector Circuit - Cylinder 1
P0202	Injector Circuit - Cylinder 2
P0203	Injector Circuit - Cylinder 3

P0204	Injector Circuit - Cylinder 4
P0205	Injector Circuit - Cylinder 5
P0206	Injector Circuit - Cylinder 6
P0207	Injector Circuit - Cylinder 7
P0208	Injector Circuit - Cylinder 8
P0209	Injector Circuit - Cylinder 9
P0210	Injector Circuit - Cylinder 10
P0211	Injector Circuit - Cylinder 11
P0212	Injector Circuit - Cylinder 12
P0213	Cold Start Injector 1
P0214	Cold Start Injector 2
P0215	Engine Shutoff Solenoid
P0216	Injector/Injection Timing Control Circuit
P0217	Engine Coolant Over Temperature Condition
P0218	Transmission Fluid Over Temperature Condition
P0219	Engine Over Speed Condition
P0220	Throttle/Pedal Position Sensor/Switch "B" Circuit
P0221	Throttle/Pedal Position Sensor/Switch "B" Circuit Range/Performance Problem
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input
P0224	Throttle/Pedal Position Sensor/Switch "B" Circuit Intermittent
P0225	Throttle/Pedal Position Sensor/Switch "C" Circuit
P0226	Throttle/Pedal Position Sensor/Switch "C" Circuit Range/Performance Problem
P0227	Throttle/Pedal Position Sensor/Switch "C" Circuit Low Input
P0228	Throttle/Pedal Position Sensor/Switch "C" Circuit High Input
P0229	Throttle/Pedal Position Sensor/Switch "C" Circuit Intermittent
P0230	Fuel Pump Primary Circuit
P0231	Fuel Pump Secondary Circuit Low
P0232	Fuel Pump Secondary Circuit High
P0233	Fuel Pump Secondary Circuit Intermittent
P0234	Turbo/Super Charger Overboost Condition
P0235	Turbo/Super Charger Boost Sensor "A" Circuit
P0236	Turbo/Super Charger Boost Sensor "A" Circuit Range/Performance
P0237	Turbo/Super Charger Boost Sensor "A" Circuit Low
P0238	Turbo/Super Charger Boost Sensor "A" Circuit High
P0239	Turbo/Super Charger Boost Sensor "B" Circuit
P0240	Turbo/Super Charger Boost Sensor "B" Circuit Range/Performance
P0241	Turbo/Super Charger Boost Sensor "B" Circuit Low
P0242	Turbo/Super Charger Boost Sensor "B" Circuit High
P0243	Turbo/Super Charger Wastegate Solenoid "A"
P0244	Turbo/Super Charger Wastegate Solenoid "A" Range/Performance
P0245	Turbo/Super Charger Wastegate Solenoid "A" Low
P0246	Turbo/Super Charger Wastegate Solenoid "A" High
P0247	Turbo/Super Charger Wastegate Solenoid "B"
P0248	Turbo/Super Charger Wastegate Solenoid "B" Range/Performance
P0249	Turbo/Super Charger Wastegate Solenoid "B" Low
P0250	Turbo/Super Charger Wastegate Solenoid "B" High
P0251	Injection Pump Fuel Metering Control "A" (Cam/rotor/Injector)
P0252	Injection Pump Fuel Metering Control "A" Range/Performance (Cam/Rotor/Injector)
P0253	Injection Pump Fuel Metering Control "A" Low (Cam/Rotor/Injector)
P0254	Injection Pump Fuel Metering Control "A" High (Cam/Rotor/Injector)
P0255	Injection Pump Fuel Metering Control "A" Intermittent (Cam/Rotor/Injector)
P0256	Injection Pump Fuel Metering Control "B" (Cam/Rotor/Injector)
P0257	Injection Pump Fuel Metering Control "B" Range/Performance (Cam/Rotor/Injector)
P0258	Injection Pump Fuel Metering Control "B" Low (Cam/Rotor/Injector)
P0259	Injection Pump Fuel Metering Control "B" High (Cam/Rotor/Injector)
P0260	Injection Pump Fuel Metering Control "B" Intermittent (Cam/Rotor/Injector)
P0261	Cylinder 1 Injector Circuit Low
P0262	Cylinder 1 Injector Circuit High
P0263	Cylinder 1 Contribution/Balance
P0264	Cylinder 2 Injector Circuit Low
P0265	Cylinder 2 Injector Circuit High
P0266	Cylinder 2 Contribution/Balance
P0267	Cylinder 3 Injector Circuit Low
P0268	Cylinder 3 Injector Circuit High
P0269	Cylinder 4 Contribution/Balance
P0270	Cylinder 4 Injector Circuit Low
P0271	Cylinder 4 Injector Circuit High

P0272 Cylinder 4 Contribution/Balance
P0273 Cylinder 5 Injector Circuit Low
P0274 Cylinder 5 Injector Circuit High
P0275 Cylinder 5 Contribution/Balance
P0276 Cylinder 6 Injector Circuit Low
P0277 Cylinder 6 Injector Circuit High
P0278 Cylinder 6 Contribution/Balance
P0279 Cylinder 7 Injector Circuit Low
P0280 Cylinder 7 Injector Circuit High
P0281 Cylinder 7 Contribution/Balance
P0282 Cylinder 8 Injector Circuit Low
P0283 Cylinder 8 Injector Circuit High
P0284 Cylinder 8 Contribution/Balance
P0285 Cylinder 9 Injector Circuit Low
P0286 Cylinder 9 Injector Circuit High
P0287 Cylinder 9 Contribution/Balance
P0288 Cylinder 10 Injector Circuit Low
P0289 Cylinder 10 Injector Circuit High
P0290 Cylinder 10 Contribution/Balance
P0291 Cylinder 11 Injector Circuit Low
P0292 Cylinder 11 Injector Circuit High
P0293 Cylinder 11 Contribution/Balance
P0294 Cylinder 12 Injector Circuit Low
P0295 Cylinder 12 Injector Circuit High
P0296 Cylinder 12 Contribution/Balance

P0298 Engine Oil Over Temperature

P03XX Ignition System or Misfire

P0300 Random/Multiple Cylinder Misfire Detected
P0301 Cylinder 1 Misfire Detected
P0302 Cylinder 2 Misfire Detected
P0303 Cylinder 3 Misfire Detected
P0304 Cylinder 4 Misfire Detected
P0305 Cylinder 5 Misfire Detected
P0306 Cylinder 6 Misfire Detected
P0307 Cylinder 7 Misfire Detected
P0308 Cylinder 8 Misfire Detected
P0309 Cylinder 9 Misfire Detected
P0310 Cylinder 10 Misfire Detected
P0311 Cylinder 11 Misfire Detected
P0312 Cylinder 12 Misfire Detected
P0313 Misfire Detected with Low Fuel
P0314 Single Cylinder Misfire (Cylinder not Specified)

P0320 Ignition/Distributor Engine Speed Input Circuit
P0321 Ignition/Distributor Engine Speed Input Circuit Range/Performance
P0322 Ignition/Distributor Engine Speed Input Circuit No Signal
P0323 Ignition/Distributor Engine Speed Input Circuit Intermittent
P0324 Knock Control System Error
P0325 Knock Sensor 1 Circuit (Bank 1 or Single Sensor)
P0326 Knock Sensor 1 Circuit Range/Performance (Bank 1 or Single Sensor)
P0327 Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)
P0328 Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)
P0329 Knock Sensor 1 Circuit Input Intermittent (Bank 1 or Single Sensor)
P0330 Knock Sensor 2 Circuit (Bank 2)
P0331 Knock Sensor 2 Circuit Range/Performance (Bank 2)
P0332 Knock Sensor 2 Circuit Low Input (Bank 2)
P0333 Knock Sensor 2 Circuit High Input (Bank 2)
P0334 Knock Sensor 2 Circuit Input Intermittent (Bank 2)
P0335 Crankshaft Position Sensor A Circuit
P0336 Crankshaft Position Sensor A Circuit Range/Performance
P0337 Crankshaft Position Sensor A Circuit Low Input
P0338 Crankshaft Position Sensor A Circuit High Input
P0339 Crankshaft Position Sensor A Circuit Intermittent
P0340 Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)
P0341 Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1 or Single Sensor)

P0342	Camshaft Position Sensor "A" Circuit Low Input	(Bank 1 or Single Sensor)
P0343	Camshaft Position Sensor "A" Circuit High Input	(Bank 1 or Single Sensor)
P0344	Camshaft Position Sensor "A" Circuit Intermittent	(Bank 1 or Single Sensor)
P0345	Camshaft Position Sensor "A" Circuit	(Bank 2)
P0348	Camshaft Position Sensor "A" Circuit Range/Performance	(Bank 2)
P0347	Camshaft Position Sensor "A" Circuit Low Input	(Bank 2)
P0348	Camshaft Position Sensor "A" Circuit High Input	(Bank 2)
P0349	Camshaft Position Sensor "A" Circuit Intermittent	(Bank 2)
P0350	Ignition Coil Primary/Secondary Circuit	
P0351	Ignition Coil "A" Primary/Secondary Circuit	
P0352	Ignition Coil "B" Primary/Secondary Circuit	
P0353	Ignition Coil "C" Primary/Secondary Circuit	
P0354	Ignition Coil "D" Primary/Secondary Circuit	
P0355	Ignition Coil "F" Primary/Secondary Circuit	
P0356	Ignition Coil "F" Primary/Secondary Circuit	
P0357	Ignition Coil "G" Primary/Secondary Circuit	
P0358	Ignition Coil "H" Primary/Secondary Circuit	
P0359	Ignition Coil "I" Primary/Secondary Circuit	
P0360	Ignition Coil "J" Primary/Secondary Circuit	
P0361	Ignition Coil "K" Primary/Secondary Circuit	
P0362	Ignition Coil "L" Primary/Secondary Circuit	
P0365	Camshaft Position Sensor "B" Circuit	(Bank 1)
P0366	Camshaft Position Sensor "B" Circuit Range/Performance	(Bank 1)
P0367	Camshaft Position Sensor "B" Circuit Low Input	(Bank 1)
P0368	Camshaft Position Sensor "B" Circuit High Input	(Bank 1)
P0369	Camshaft Position Sensor "B" Circuit Intermittent	(Bank 1)
P0370	Timing Reference High Resolution Signal "A"	
P0371	Timing Reference High Resolution Signal "A" Too Many Pulses	
P0372	Timing Reference High Resolution Signal "A" Too Few Pulses	
P0373	Timing Reference High Resolution Signal "A" Intermittent/Erratic Pulses	
P0374	Timing Reference High Resolution Signal "A" No Pulse	
P0375	Timing Reference High Resolution Signal "B"	
P0376	Timing Reference High Resolution Signal "B" Too Many Pulses	
P0377	Timing Reference High Resolution Signal "B" Too Few Pulses	
P0378	Timing Reference High Resolution Signal "B" Intermittent/Erratic Pulses	
P0379	Timing Reference High Resolution Signal "B" No Pulses	
P0380	Glow Plug/Heater Circuit "A"	
P0381	Glow Plug/Heater Indicator Circuit	
P0382	Glow Plug/Heater Circuit "B"	
P0385	Crankshaft Position Sensor "B" Circuit	
P0386	Crankshaft Position Sensor "B" Circuit Range/Performance	
P0387	Crankshaft Position Sensor "B" Circuit Low Input	
P0388	Crankshaft Position Sensor "B" Circuit High Input	
P0389	Crankshaft Position Sensor "B" Circuit Intermittent	
P0390	camshaft Position Sensor "B" Circuit	
P0391	Camshaft Position Sensor "B" circuit Range/Performance	(Bank 2)
P0392	Camshaft Position Sensor "B" Circuit Low Input	(Bank 2)
P0393	Camshaft Position Sensor "B" Circuit High Input	(Bank 2)
P0394	Camshaft Position Sensor "B" Circuit Intermittent	(Bank 2)

P04XX Auxiliary Emission Controls

P0400	Exhaust Gas Recirculation Flow	
P0401	Exhaust Gas Recirculation Flow Insufficient Detected	
P0402	Exhaust Gas Recirculation Flow Excessive Detected	
P0403	Exhaust Gas Recirculation Control Circuit	
P0404	Exhaust Gas Recirculation Control Circuit Range/Performance	
P0405	Exhaust Gas Recirculation Sensor "A" Circuit Low	
P0406	Exhaust Gas Recirculation Sensor "A" Circuit High	
P0407	Exhaust Gas Recirculation Sensor "B" Circuit Low	
P0408	Exhaust Gas Recirculation Sensor "B" Circuit High	
P0409	Exhaust Gas Recirculation Sensor "A" Circuit	
P0410	Secondary Air Injection System	
P0411	Secondary Air Injection System Incorrect Flow Detected	
P0412	Secondary Air Injection System Switching Valve "A" Circuit	
P0413	Secondary Air Injection System Switching Valve "A" Circuit Open	

P0414	Secondary Air Injection System Switching Valve "A" Circuit Shorted	
P0415	Secondary Air Injection System Switching Valve "B" Circuit	
P0416	secondary Air Injection System Switching Valve "B" Circuit Open	
P0417	secondary Air Injection System Switching Valve "B" Circuit Shorted	
P0416	Secondary Air Injection System Relay "A" Circuit	
P0419	Secondary Air injection System Relay "B" Circuit	
P0420	Catalyst System Efficiency Below Threshold	(Bank 1)
P0421	Warm Up Catalyst Efficiency Below Threshold	(Bank 1)
P0422	Main Catalyst Efficiency Below Threshold	(Bank 1)
P0423	Heated Catalyst Efficiency Below Threshold	(Bank 1)
P0424	Heated Catalyst Temperature Below Threshold	(Bank 1)
P0425	Catalyst Temperature Sensor	(Bank 1)
P0426	Catalyst Temperature Sensor Range/Performance	(Bank 1)
P0427	Catalyst Temperature Sensor Low Input	(Bank 1)
P0428	Catalyst Temperature Sensor High Input	(Bank 1)
P0429	Catalyst Heater Control Circuit	(Bank 1)
P0430	Catalyst System Efficiency Below Threshold	(Bank 2)
P0431	Warm Up Catalyst Efficiency Below Threshold	(Bank 2)
P0432	Main Catalyst Efficiency Below Threshold	(Bank 2)
P0433	Heated Catalyst Efficiency Below Threshold	(Bank 2)
P0434	Heated Catalyst Temperature Below Threshold	(Bank 2)
P0435	Catalyst Temperature Sensor	(Bank 2)
P0436	Catalyst Temperature Sensor Range/Performance	(Bank 2)
P0437	Catalyst Temperature Sensor Low Input	(Bank 2)
P0438	Catalyst Temperature Sensor High Input	(Bank 2)
P0439	Catalyst Heater Control Circuit	(Bank 2)
P0440	Evaporative Emission Control System	
P0441	Evaporative Emission Control System Incorrect Purge Flow	
P0442	Evaporative Emission Control System Leak Detected (small leak)	
P0443	Evaporative Emission Control System Purge Control Valve Circuit	
P0444	Evaporative Emission Control System Purge Control Valve Circuit Open	
P0445	Evaporative Emission Control System Purge Control Valve Circuit Shorted	
P0446	Evaporative Emission Control System Vent Control Circuit	
P0447	Evaporative Emission Control System Vent Control Circuit Open	
P0448	Evaporative Emission Control System Vent Control Circuit Shorted	
P0449	Evaporative Emission Control System Vent Valve/Solenoid Circuit	
P0450	Evaporative Emission Control System Pressure Sensor	
P0451	Evaporative Emission Control System Pressure Sensor Range/Performance	
P0452	Evaporative Emission Control System Pressure Sensor Low Input	
P0453	Evaporative Emission Control System Pressure Sensor High input	
P0454	Evaporative Emission Control System Pressure Sensor Intermittent	
P0455	Evaporative Emission Control System Leak Detected (gross leak)	
P0456	Evaporative Emission Control System Leak Detected (very small leak)	
P0457	Evaporative Emission Control System Leak Detected (fuel cap loose/off)	
P0460	Fuel Level Sensor Circuit	
P0461	Fuel Level Sensor Circuit Range/Performance	
P0462	Fuel Level Sensor Circuit Low Input	
P0463	Fuel Level Sensor Circuit High Input	
P0464	Fuel Level Sensor Circuit Intermittent	
P0465	EVAP Purge Flow Sensor Circuit	
P0466	EVAP Purge Flow Sensor Circuit Range/Performance	
P0467	EVAP Purge Flow Sensor Circuit Low Input	
P0468	EVAP Purge Flow Sensor Circuit High Input	
P0469	EVAP Purge Flow Sensor Circuit Intermittent	
P0470	Exhaust Pressure Sensor	
P0471	Exhaust Pressure Sensor Range/Performance	
P0472	Exhaust Pressure Sensor Low	
P0473	Exhaust Pressure Sensor High	
P0474	Exhaust Pressure Sensor Intermittent	
P0475	Exhaust Pressure Control Valve	
P0476	Exhaust Pressure Control Valve Range/Performance	
P0477	Exhaust Pressure Control Valve Low	
P0478	Exhaust Pressure Control Valve High	
P0479	Exhaust Pressure Control Valve Intermittent	
P0480	Cooling Fan 1 Control Circuit	
P0481	Cooling Fan 2 Control Circuit	
P0482	Cooling Fan 3 Control Circuit	
P0483	Cooling Fan Rationality Check	

P0484	Cooling Fan Circuit Over Current	
P0485	Cooling Fan Power/Ground Circuit	
P0486	Exhaust Gas Recirculation Sensor "B" Circuit	
P0487	Exhaust Gas Recirculation Throttle Position Control Circuit	
P0488	Exhaust Gas Recirculation Throttle Position Control Range/Performance	
P0491	Secondary Air Injection System	(Bank 1)
P0492	Secondary Air Injection System	(Bank 2)

P05XX Vehicle Speed, Idle Control, and Auxiliary Inputs

P0500	Vehicle Speed Sensor	
P0501	Vehicle Speed Sensor Range/Performance	
P0502	Vehicle Speed Sensor Circuit Low Input	
P0503	Vehicle Speed Sensor Intermittent/Erratic/High	
P0505	Idle Control System	
P0506	Idle Control System RPM Lower Than Expected	
P0507	Idle Control System RPM Higher Than Expected	
P0508	Idle Control System Circuit Low	
P0509	Idle Control System Circuit High	
P0510	Closed Throttle Position Switch	
P0512	Starter Request Circuit	
P0513	Incorrect Immobilizer Key (*Immobilizer pending SAE J1930 approval)	
P0515	Battery Temperature Sensor Circuit	
P0516	Battery Temperature Sensor Circuit Low	
P0517	Battery Temperature Sensor Circuit High	
P0520	Engine Oil Pressure Sensor/Switch Circuit	
P0521	Engine Oil Pressure Sensor/Switch Range/Performance	
P0522	Engine Oil Pressure Sensor/Switch Low Voltage	
P0523	Engine Oil Pressure Sensor/Switch High Voltage	
P0524	Engine Oil Pressure Too Low	
P0530	A/C Refrigerant Pressure Sensor Circuit	
P0531	A/C Refrigerant Pressure Sensor Circuit Range/Performance	
P0532	A/C Refrigerant Pressure Sensor Circuit Low Input	
P0533	A/C Refrigerant Pressure Sensor Circuit High Input	
P0534	Air Conditioner Refrigerant Charge Loss	
P0540	Intake Air Heater Circuit	
P0541	Intake Air Heater Circuit Low	
P0542	Intake Air Heater Circuit High	
P0544	Exhaust Gas Temperature Sensor Circuit	(Bank 1)
P0545	Exhaust Gas Temperature Sensor Circuit Low	(Bank 1)
P0546	Exhaust Gas Temperature Sensor Circuit High	(Bank 1)
P0547	Exhaust Gas Temperature Sensor Circuit	(Bank 2)
P0548	Exhaust Gas Temperature Sensor Circuit Low	(Bank 2)
P0549	Exhaust Gas Temperature Sensor Circuit High	(Bank 2)
P0550	Power Steering Pressure Sensor Circuit	
P0551	Power Steering Pressure Sensor Circuit Range/Performance	
P0552	Power Steering Pressure Sensor Circuit Low Input	
P0553	Power Steering Pressure Sensor Circuit High Input	
P0554	Power Steering Pressure Sensor Circuit Intermittent	
P0560	System Voltage	
P0561	System Voltage Unstable	
P0562	System Voltage Low	
P0563	System Voltage High	
P0564	Cruise Control Multi-Function Input Signal	
P0565	Cruise Control On Signal	
P0566	Cruise Control Off Signal	
P0567	Cruise Control Resume Signal	
P0568	Cruise Control Set Signal	
P0569	Cruise Control Coast Signal	
P0570	Cruise Control Accel Signal	
P0571	Cruise Control/Brake Switch A Circuit	
P0572	Cruise Control/Brake Switch A Circuit Low	

P0573 Cruise Control/Brake Switch A Circuit High
P0574 Cruise Control System - Vehicle Speed Too High
P0575 Cruise Control Input Circuit
P0576 Cruise Control Input Circuit Low
P0577 Cruise Control input Circuit High
P0578 through P0580 Reserved for Cruise Control Codes

P06XX Computer and Auxiliary Inputs

P0600 Serial Communication Link
P0601 Internal Control Module Memory Check Sum Error
P0602 Control Module Programming Error
P0603 Internal Control Module Keep Alive Memory (KAM) Error
P0604 Internal Control Module Random Access Memory (RAM) Error
P0605 Internal Control Module Read Only Memory (ROM) Error (Module Identification Defined by SAE J1979)

P0606 ECM/PCM Processor
P0607 Control Module Performance
P0608 Control Module VSS Output "A"
P0609 Control Module VSS Output "B"
P0610 Control Module Vehicle Options Error

P0615 Starter Relay Circuit
P0616 Starter Relay Circuit Low
P0617 Starter Relay Circuit High
P0618 Alternative Fuel Control Module KAM Error
P0619 Alternative Fuel Control Module RAM/ROM Error
P0620 Generator Control Circuit
P0621 Generator Lamp "L" Terminal Control Circuit
P0622 Generator Field "F" Terminal Control Circuit
P0623 Generator Lamp Control Circuit
P0624 Fuel Cap Lamp Control Circuit

P0630 VIN Not Programmed or Mismatch - ECM/PCM
P0631 VIN Not Programmed or Mismatch - TCM

P0635 Power Steering Control Circuit
P0836 Power Steering Control Circuit Low
P0637 Power Steering Control Circuit High
P0638 Throttle Actuator Control Range/Performance (Bank 1)
P0639 Throttle Actuator Control Range/Performance (Bank 2)
P0640 Intake Air Heater Control Circuit

P0645 A/C Clutch Relay Control Circuit
P0646 A/C Clutch Relay Control Circuit Low
P0647 A/C Clutch Relay Control Circuit High
P0648 Immobilizer Lamp Control Circuit ("Immobilizer" pending SAE J1930 approval)
P0649 Speed Control Lamp Control Circuit
P0650 Malfunction Indicator Lamp (ML) Control Circuit

P0654 Engine RPM Output Circuit
P0655 Engine Hot Lamp Output Control Circuit
P0656 Fuel Level Output Circuit

P0660 Intake Manifold Tuning Valve Control Circuit (Bank 1)
P0661 Intake Manifold Tuning Valve Control Circuit Low (Bank 1)
P0662 Intake Manifold Tuning Valve Control Circuit High (Bank 1)
P0663 Intake Manifold Tuning Valve Control Circuit (Bank 2)
P0664 Intake Manifold Tuning Valve Control Circuit Low (Bank 2)
P0665 Intake Manifold Tuning Valve Control Circuit High (Bank 2)

P07XX Transmission

P0700 Transmission Control System (MIL Request)
P0701 Transmission Control System Range/Performance
P0702 Transmission Control System Electrical
P0703 Torque Converter/Brake Switch B Circuit
P0704 Clutch Switch Input Circuit Malfunction

P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)
P0706	Transmission Range Sensor Circuit Range/Performance
P0707	Transmission Range Sensor Circuit Low Input
P0708	Transmission Range Sensor Circuit High Input
P0709	Transmission Range Sensor Circuit intermittent
P0710	Transmission Fluid Temperature Sensor Circuit
P0711	Transmission Fluid Temperature Sensor Circuit Range/Performance
P0712	Transmission Fluid Temperature Sensor Circuit Low Input
P0713	Transmission Fluid Temperature Sensor Circuit High Input
P0714	Transmission Fluid Temperature Sensor Circuit Intermittent
P0715	Input/Turbine Speed Sensor Circuit
P0716	input/Turbine Speed Sensor Circuit Range/Performance
P0717	Input/Turbine Speed Sensor Circuit No Signal
P0718	Input/Turbine Speed Sensor Circuit Intermittent
P0719	Torque Converter/Brake Switch B Circuit Low
P0720	Output Speed Sensor Circuit
P0721	Output Speed Sensor Circuit Range/Performance
P0722	Output Speed Sensor Circuit No Signal
P0723	Output Speed Sensor Circuit Intermittent
P0724	Torque Converter/Brake Switch B Circuit High
P0725	Engine Speed Input Circuit
P0726	Engine Speed Input Circuit Range/Performance
P0727	Engine Speed Input Circuit No Signal
P0728	Engine Speed Input Circuit Intermittent
P0730	Incorrect Gear Ratio
P0731	Gear 1 Incorrect Ratio
P0732	Gear 2 Incorrect Ratio
P0733	Gear 3 Incorrect Ratio
P0734	Gear 4 Incorrect Ratio
P0735	Gear 5 Incorrect Ratio
P0736	Reverse Incorrect Ratio
P0737	TCM Engine Speed Output Circuit
P0739	TCM Engine Speed Output Circuit Low
P0739	TCM Engine Speed Output Circuit High
P0740	Torque Converter Clutch Circuit
P0741	Torque Converter Clutch Circuit Performance or Stuck Off
P0742	Torque Converter Clutch Circuit Stuck On
P0743	Torque Converter Clutch Circuit Electrical
P0744	Torque Converter Clutch Circuit Intermittent
P0745	Pressure Control Solenoid "A"
P0746	Pressure Control Solenoid "A" Performance or Stuck Off
P0747	Pressure Control Solenoid "A" Stuck On
P0748	Pressure Control Solenoid "A" Electrical
P0749	Pressure Control Solenoid "A" Intermittent
P0750	Shift Solenoid "A"
P0751	Shift Solenoid "A" Performance or Stuck Off
P0752	Shift Solenoid "A" Stuck On
P0753	Shift Solenoid "A" Electrical
P0754	Shift Solenoid "A" Intermittent
P0765	Shift Solenoid "B"
P0756	Shift Solenoid "B" Performance or Stuck Off
P0757	Shift Solenoid "B" Stuck On
P0758	Shift Solenoid "B" Electrical
P0759	Shift Solenoid "B" Intermittent
P0760	Shift Solenoid "C"
P0761	Shift Solenoid "C" Performance or Stuck Off
P0762	Shift Solenoid "C" Stuck On
P0763	Shift Solenoid "C" Electrical
P0764	Shift Solenoid "C" Intermittent
P0765	Shift Solenoid "C"
P0766	Shift Solenoid "D" Performance or Stuck Off
P0767	Shift Solenoid "D" Stuck On
P0768	Shift Solenoid "D" Electrical
P0769	Shift Solenoid "D" Intermittent
P0770	Shift Solenoid "E"
P0771	Shift Solenoid "E" Performance or Stuck Off
P0772	Shift Solenoid "E" Stuck On
P0773	Shift Solenoid "E" Electrical

P0774	Shift Solenoid "E" Intermittent
P0775	Pressure Control Solenoid "B"
P0776	Pressure Control Solenoid "B" Performance or Stuck Off
P0777	Pressure Control Solenoid "B" Stuck On
P0778	Pressure Control Solenoid "B" Electrical
P0779	Pressure Control Solenoid "B" Intermittent
P0780	Shift
P0781	1-2 Shift
P0782	2-3 Shift
P0783	3-4 Shift
P0784	4-5 Shift
P0785	Shift/Timing Solenoid
P0786	Shift/Timing Solenoid Range/Performance
P0787	Shift/Timing Solenoid Low
P0788	Shift/Timing Solenoid High
P0789	Shift/Timing Solenoid Intermittent
P0790	Normal/Performance Switch Circuit
P0791	Intermediate Shaft Speed Sensor Circuit
P0792	Intermediate Shaft Speed Sensor Circuit Range/Performance
P0793	Intermediate Shaft Speed Sensor Circuit No Signal
P0794	Intermediate Shaft Speed Sensor Circuit Intermittent
P0795	Pressure Control Solenoid "C"
P0796	Pressure Control Solenoid "C" Performance or Stuck off
P0797	Pressure Control Solenoid "C" Stuck On
P0798	Pressure Control Solenoid "C" Electrical
P0799	Pressure Control Solenoid "C" Intermittent

P08XX Transmission

P0801	Reverse Inhibit Control Circuit
P0803	1-4 Upshift (Skip Shift) Solenoid Control Circuit
P0804	1-4 Upshift (Skip Shift) Lamp Control Circuit
P0805	Clutch Position Sensor Circuit
P0806	Clutch Position Sensor Circuit Range/Performance
P0807	Clutch Position Sensor Circuit Low
P0808	Clutch Position Sensor Circuit High
P0809	Clutch Position Sensor Circuit Intermittent
P0810	Clutch Position Control Error
P0811	Excessive Clutch Slippage
P0812	Reverse Input Circuit
P0813	Reverse Output Circuit
P0814	Transmission Range Display Circuit
P0815	Upshift Switch Circuit
P0816	Downshift Switch Circuit
P0817	Starter Disable Circuit
P0818	Driveline Disconnect Switch Input Circuit
P0820	Gear Lever X-Y Position Sensor Circuit
P0821	Gear Lever X Position Circuit
P0822	Gear Lever Y Position Circuit
P0823	Gear Lever X Position Circuit Intermittent
P0824	Gear Lever Y Position Circuit Intermittent
P0825	Gear Lever Push-Pull Switch (Shift Anticipate)
P0830	Clutch Pedal Switch "A" Circuit
P0831	Clutch Pedal Switch "A" Circuit Low
P0832	Clutch Pedal Switch "A" Circuit High
P0833	Clutch Pedal Switch "B" Circuit
P0834	Clutch Pedal Switch "B" Circuit Low
P0835	Clutch Pedal Switch "B" Circuit High
P0836	Four Wheel Drive (4WD) Switch Circuit
P0837	Four Wheel Drive (4WD) Switch Circuit Range/Performance
P0838	Four Wheel Drive (4WD) Switch Circuit Low
P0839	Four Wheel Drive (4WD) Switch Circuit High
P0840	Transmission Fluid Pressure Sensor/Switch "A" Circuit
P0841	Transmission Fluid Pressure Sensor/Switch "A" Circuit Range/Performance
P0842	Transmission Fluid Pressure Sensor/Switch "A" Circuit Low

P0843	Transmission Fluid Pressure Sensor/Switch "A" Circuit High
P0844	Transmission Fluid Pressure Sensor/Switch "A" Circuit Intermittent
P0845	Transmission Fluid Pressure Sensor/Switch "B" Circuit
P0846	Transmission Fluid Pressure Sensor/Switch "B" Circuit Range/Performance
P0847	Transmission Fluid Pressure Sensor/Switch "B" Circuit Low
P0848	Transmission Fluid Pressure Sensor/Switch "B" Circuit High
P0849	Transmission Fluid Pressure Sensor/Switch "B" Circuit Intermittent

Additional Diagnostic Trouble Code Ranges

Other DTC ranges are defined for either manufacturer specific codes or under the control of SAE (Society of Automotive Engineers) and not yet defined. This section documents these additional ranges. Refer to your vehicle's repair manual for manufacturer specific Diagnostic Trouble Codes.

P09XX Transmission

P1XXX Manufacturer Controlled

P10XX Fuel and Air Metering and Auxiliary Emission Controls

P11XX Fuel and Air Metering

P12XX Fuel and Air Metering

P13XX Ignition System or Misfire

P14XX Auxiliary Emission Controls

P15XX Vehicle Speed, Idle Control, and Auxiliary Inputs

P16XX Computer and Auxiliary Outputs

P17XX Transmission

P18XX Transmission

P19XX Transmission

P2XXX SAE Controlled DTCs

P20XX Fuel and Air Metering and Auxiliary Emission Controls

P21XX Fuel and Air Metering and Auxiliary Emission Controls

P22XX Fuel and Air Metering and Auxiliary Emission Controls

P23XX Ignition System or Misfire

P24XX SAE Reserved

P25XX SAE Reserved

P26XX SAE Reserved

P27XX SAE Reserved

P28XX SAE Reserved

P29XX SAE Reserved

P3XX Manufacturer Controlled and SAE Reserved

P30XX Fuel and Air Metering and Auxiliary Emission Controls

P31XX Fuel and Air Metering and Auxiliary Emission Controls

P32XX Fuel and Air Metering and Auxiliary Emission Controls

P33XX Ignition System Misfire

P34XX SAE Reserved

P35XX SAE Reserved

P36XX SAE Reserved

P37XX SAE Reserved

P38XX SAE Reserved

P39XX SAE Reserved

Appendix B: Support

Technical support is offered on our products via email. Please note technical support cannot assist you in diagnosing and repairing your vehicle. Support is limited to operation of the scan tool only.

When contacting technical support please provide the following information:

- Year of Vehicle (e.g. 1997)
- Make (e.g. Chevrolet)
- Model (e.g. K1500 Pickup Extended Cab)
- Palm handheld used (e.g. Palm V)
- Problem encountered, be specific as possible. List any error messages displayed by the software.
- Version of the Software (located on the Options | About menu).

Appendix C: Warranty Information

Nology Engineering, Inc. offers a Limited Lifetime Warranty (see below). Damage caused by misuse or modification is not covered.

Nology Engineering, Inc. is not responsible for damage to vehicle caused by misuse or otherwise. Nology Engineering, Inc. sole liability is limited to the repair or replacement of the scan tool while under warranty.

30-day money back guarantee. If for any reason you are not satisfied with the PDA-Dyno™, you can return it to the original place of purchase for a refund less shipping charges.

The scan tool must be undamaged and contain all original packing, supplied materials, and the original receipt or packing slip. No refunds after 30-days. Email or call for a RMA before returning. Returns received without an RMA number will be refused.

When contacting Nology Engineering, Inc. for an RMA please provide the following information:

- Reason for returning the scan tool
- Year of Vehicle (e.g. 1997)
- Make (e.g. Chevrolet)
- Model (e.g. K1500 Pickup Extended Cab)
- Palm handheld used (e.g. Palm V)
- Problem encountered, if any.
- Original Invoice Number

Nology Engineering, Inc.

1945 S Rancho Santa Fe Rd

San Marcos, CA 92069

Or email for an RMA at: sales@nology.com.

LIMITED LIFETIME WARRANTY

Nology warrants the PDA-Dyno to the original purchaser against material or factory workmanship defects when used on private vehicles under normal operating conditions. The warranty does not apply to alterations or misuse which result in failure and does not cover commercial, racing or industrial applications. This warranty does not in any way extend to consequential damages due to a defective part or material, accidents, driver negligence, incorrect installation and/or application. Nology assumes no responsibility for diagnosis, removal and/or installation labor, loss of vehicle use, loss of time, inconvenience or any other consequential expenses. If warranty is required, return the Product with the original invoice to the Nology dealer from which it was purchased or to Nology for verification under this warranty. A completed warranty card must be on file with Nology. All returns must be authorized in advance and accompanied by a return authorization number. Freight must be prepaid by customer. If product is found to be defective it will be repaired free of charge or exchanged, at Nology's sole discretion. Repairs or exchanges will not be issued if merchandise has been damaged or abused. The warranties herein are in lieu of any other expressed or implied warranties, including any implied warranty of merchantability or fitness, and any other obligation on the part of Nology, or selling dealers. This warranty gives you specific rights and you may also have other rights which vary from state to state.

Appendix D: Legal

Disclaimer

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